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# STATUS OF ATLANTIC SALMON ON PRINCE EDWARD ISLAND IN 1996

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## Abstract

Salmon, historically abundant in Prince Edward Island, were eliminated from most streams following European colonization. Since the mid-1980s enhancement and stocking efforts have re-established salmon runs, primarily of hatchery-reared fish, on several PEI rivers. Conservation requirements, developed for rivers with natural salmon runs, are calculated as the spawning escapement that produces 2.4 eggs $m^{-2}$ of river area. On this basis conservation requirements are 537 large salmon and 288 small salmon for the five most important salmon streams on PEI, including 159 large salmon and 85 small salmon for the Morell, which is PEI's most important salmon stream.

Salmon stocking on PEI relies chiefly on fish that are reared in semi-natural open impoundments and released as 2+ smolts. An estimated 42,691 juvenile salmon were released into the Morell in spring 1996, based on a presumed 65% survival rate of 1+ parr placed in the pond in June 1995.

A licence stub survey estimated that anglers harvested 534 small salmon from PEI in 1996 during 6,478 rod-days. Estimates for the Morell were 397 retained small salmon and 4,156 rod-days. An additional 17 small salmon were taken by native harvesters in the Morell.

Counts of salmon ascending the fishway to Leards Pond totaled 249, of which 60 were removed for broodstock. Sample composition was 88% small (<63 cm fork length) and 86% hatchery in origin. A mark-recapture experiment was conducted at Leards Pond and at Mooneys Pond to determine the capture efficiency of the Leards counting facility. Thirty-four of 103 fish captured at Mooneys had been marked at Leards. The median Bayesian estimate of fish entering Leards Pond, adjusted for late running fish which did not ascend to Mooneys, was 563 fish. Counters enumerated 438 salmon redds on the Morell in 1996, of which 308 were above Leards Pond.

Counts at the Valleyfield River fence totaled 75 small and eight large salmon, the largest run in the time series.

Length distributions of juvenile salmon taken during electrofishing surveys were tri-modal, suggesting the presence of 0+, 1+, and 2+ age groups. River-wide juvenile populations, based on 14 electrofishing surveys in August-September and partitioned by age according to length distributions, were 24,312 0+ fish, 7,885 1+ fish, and 9,411 2+ fish.

The return rate of Atlantic salmon stocked above Leards, calculated from the mark-recapture estimate of arrivals to Leards, was 6%. However, this return rate contains substantial uncertainty because the number of fish released in 1995 is not reliably known.

The total 1996 Morell run can be calculated from the 1995 run as estimated by a mark-recapture experiment, assuming a constant efficiency of the Leards trap and a constant distribution of ascending fish to Leards and other destinations. The 1996 run estimated in this fashion 1,920 fish. Exploitation rate based on the stub survey and this estimate was 23.5%.

Salmon entering Leards Pond, corrected for trap efficiency but not adjusted for angler mortality, had a potential spawning deposition of 435,406 eggs in 1996. This represents 243% of calculated conservation requirement. For the Morell as a whole, an estimated post-fishery spawning escapement of 1,523 fish produced 1,537,225 eggs, which is 270% of conservation requirement. No other rivers on PEI have come close to achieving conservation requirements in recent years.



## Résumé

Le saumon qui historiquement était abondant à l'Île-du-Prince-Édouard a disparu de la plupart des cours d'eau par suite de la colonisation par les Européens. Des efforts de mise en valeur et d'ensemencement menés depuis le milieu des années 1980 ont permis de rétablir les montaisons de saumon, essentiellement du saumon d'élevage, dans plusieurs rivières de l'Île-du-Prince-Édouard. Afin de garantir la conservation dans les rivières où il se produit naturellement des montaisons de saumon, on a déterminé qu'il fallait un taux d'échappée des géniteurs produisant 2,4 oeufs par $m^2$ de fond de rivière. Or, pour assurer la conservation, il faudrait 537 gros saumons et 288 petits saumons dans les cinq plus importants cours d'eau à saumons de l'Î.-P.-É., dont 159 gros saumons et 85 petits saumons pour la rivière Morell, la plus importante rivière à saumons de l'Île-du-Prince-Édouard.

À l'Île-du-Prince-Édouard, pour ensemencer les cours d'eau, on compte essentiellement sur les poissons élevés dans des bassins ouverts semi-naturels qui sont relâchés comme samoneaux de deux ans et plus. On évalue à 42 691 le nombre de saumons juvéniles qui ont été relâchés dans la rivière Morell au printemps de 1996, et ce en se fondant sur un taux de survie présumé de 65 % des tacons âgés de 1+ qui avaient été placés dans le bassin au mois de juin 1995.

D'après un relevé des talons de permis de pêche, il est évalué que les pêcheurs à la ligne ont pris 534 petits saumons des cours d'eau de l'Île-du-Prince-Édouard en 1996, et ce au cours de 6 478 jours de pêche. Pour la rivière Morell, il y aurait eu 397 petits saumons de pris pendant 4 156 jours de pêche. Toujours dans la rivière Morell, dix-sept autres saumons ont été capturés par des pêcheurs autochtones.

Les dénombrements de saumons remontant l'échelle à poisson de l'étang Leards s'établissaient au total à 249, dont 60 ont été prélevés comme géniteurs. L'échantillon se présentait comme suit : 88 % de petits saumons (< 63 cm longueur à la fourche) et 86 % des poissons avaient été élevés en écloserie. Une expérience de marquage et de recapture a été menée à l'étang Leards et à l'étang Mooneys afin d'évaluer l'efficacité de capture de l'installation de dénombrement de l'étang Leards. Trente-quatre des 103 poissons capturés à l'étang Mooneys avaient été marqués à l'étang Leards. L'estimation bayésienne moyenne du nombre de poissons qui pénètrent dans l'étang Leards - ajustée pour tenir compte des poissons de montaison tardive qui ne se sont pas rendus jusqu'à l'étang Mooneys - était de 563 poissons. Les compteurs ont dénombré 438 nids de saumons dans la rivière Morell en 1996, dont 308 se trouvaient en amont de l'étang Leards.

Les dénombrements à la barrière de la rivière Valleyfield totalisaient 75 petits saumons et huit gros saumons, ce qui représente la plus importante montaison de la série chronologique.

Les distributions selon la longueur des saumons juvéniles capturés pendant les relevés de la pêche à l'électricité attestaient la présence de trois groupes d'âge : 0+, 1+ et 2+. D'après 14 relevés de pêche à l'électricité effectués dans toute la rivière en août et septembre, les populations de

juvéniles répartis selon l'âge et la longueur se présentaient comme suit : 24 312 poissons de 0+, 7 885 poissons de 1+ et 9 411 poissons âgés de 2+.

Le taux de retour du saumon atlantique ensemencé en amont de l'étang Leards, calculé à partir des évaluations découlant du marquage et des recaptures des arrivants à l'étang Leards était de 6 %. Ce taux de retour n'est cependant pas du tout fiable puisque l'on ne connaît pas avec certitude le nombre de poissons relâchés en 1995.

Il est possible de calculer la montaison globale de 1996 dans la rivière Morell à partir de la montaison de 1995 estimée par l'expérience de marquage et de recapture, et ce en présumant une efficacité constante du trappe de l'étang Leards et une distribution constante du nombre de poissons remontant la rivière en direction de l'étang Leards et d'autres destinations. La montaison de 1996 ainsi évaluée se chiffrerait à 1 920 poissons. D'après le relevé des talons de permis de pêche et cette estimation, le taux d'exploitation s'établirait à 23,5 %.

Le saumon pénétrant dans l'étang Leards, compte tenu d'une correction pour l'efficacité du trappe mais sans ajustement pour la mortalité due à la pêche, avait en 1996 un potentiel de fraie de 435 406 oeufs. Ceci correspond à 243 % du besoin calculé aux fins de la conservation. Pour l'ensemble de la rivière Morell, une échappée approximative après la pêche de 1 523 poissons ont produit 1 537 225 oeufs, c'est-à-dire 270 % des besoins fixés pour la conservation. Aucune autre rivière de l'Île-du-Prince-Édouard n'est venue près d'atteindre un tel niveau de conservation au cours des dernières années.

## Introduction

Because of its insular status, Prince Edward Island has a low diversity of freshwater fishes, and native game fish are limited to brook trout and Atlantic salmon. Early accounts indicated an abundance of salmon in the Island's short, barrier-free rivers, with fish arriving on the north shore in June and July and on the south shore in September and October (Dunfield 1985). A substantial commercial salmon fishery developed during the first half of the 18th century, with the greatest activity focused on the St. Peters Bay area.

Despite the imposition of fishing restrictions as early as 1780, salmon declined rapidly and were eliminated from many rivers early in the 19th century (Dunfield 1985). Nevertheless a commercial fishery persisted. Some 10.5 tonnes of salmon were exported in 1865, and 727 kg were taken from the St. Peters Bay area in 1893 (Dunfield 1985). In the 20th century the salmon resource declined further, and by the mid-1970s few or no fish were being taken on the Morell River, which is the largest river emptying into St. Peters Bay (Table 1, Figs. 1-3).

At the present time, brook trout are ubiquitous in PEI streams, but salmon are commonly found in only a few of the larger rivers. Rainbow trout have been widely introduced, and have become established in a few watercourses.

In the early 1980s concerted efforts were launched to restore the Atlantic salmon populations of PEI rivers. Through the combined efforts of federal and provincial agencies and volunteer groups, enhancement programs were initiated on the Mill and Morell Rivers (Bielak et al. 1991; Figs. 1 and 2). These programs included habitat improvement, selective breeding of early-run genetic stocks, and the development of semi-natural pond rearing of smolts. The semi-natural rearing facility at Profitts Pond on the Mill River watershed began rearing salmon in 1984, and the Mooneys Pond facility on the Morell began operation in 1989. At both sites, volunteer groups (the O'Leary Wildlife Federation, the Morell River Management Co-op) raised fish furnished by the Cardigan Salmonid Enhancement Centre (SEC) of the Department of Fisheries and Oceans. These enhancement efforts were most successful in the Morell River, which by the late 1980s yielded annual angling harvests of several hundred salmon.

Habitat enhancement and stocking efforts have also been directed at the Dunk, West, and Valleyfield Rivers. In 1994, the Montague Watershed Management Co-op, in cooperation with the Cardigan SEC, set up a new semi-natural rearing facility at Gilberts Pond, and in the following year, established a cage culture facility at Munns Pond (Fig. 1).

The Morell River, in east-central PEI, drains an area of 171 $km^2$. This document gives an update of the Atlantic salmon resource in the Morell, which remains the most important salmon stream on PEI, and reports stocking and monitoring efforts in the Mill, Dunk, West, and Valleyfield Rivers. In this paper, adult salmon under 63 cm in fork length are referred to as "small salmon" and fish this length or greater are called "large salmon." Most fish classified as small salmon have spent one winter at sea and most fish classified as large salmon have spent two or more winters at sea.

The status of Atlantic salmon on the Morell and on PEI has been previously reviewed by Ducharme (1977), Bielak et al. (1991), Davidson and Bielak (1992), Davidson and Angus (1994), and Cairns et al. (1995, 1996).

## Description of Fisheries

In most PEI waters the 1996 angling season for Atlantic salmon was 15 June - 15 September, but other open seasons applied in some rivers. In the Morell River, salmon fishing opened on 1 June and continued to 14 October at most sites (Table 2). In the main branch from MacKays to the Forks (Fig. 2) the salmon season continued to 31 October, and in Leards Pond it continued to 30 November. The extension of salmon fishing to 31 October also applied to the Valleyfield River below MacRaes Dam, the West River below Rte. 249, the Dunk River below Scales Pond, and the Mill River below Route 148.

The daily bag limit was one small salmon and the season limit was seven. Retention of large salmon was prohibited.

Residents of Prince Edward Island between the ages of 16 and 64 who are not farmers, commercial fishermen, or aboriginals were required to purchase a licence in order to fish for trout on PEI in 1996. Residents over 65 and farmers and commercial fishermen had to obtain a Courtesy or Farmer/fisher licence, issued gratis. Non-residents required a non-resident trout licence. To fish for salmon, an angler required both a salmon licence and the appropriate trout licence.

The number of angling licences issued on PEI in 1996 is as follows:

| | |
|---|---|
| Resident trout | 9,338 |
| Courtesy resident trout (over 65) | 1,633 |
| Farmer/Commercial Fisher | 1,608 |
| Non-resident trout | 1,101 |
| Total seasonal trout | 13,680 |
| Non-resident day trout | 230 |
| Salmon | 697 |

The Department of Fisheries and Oceans and the PEI Native Council concluded an agreement providing for a native allocation of 400 small Atlantic salmon from the Morell River in 1996.

## Conservation requirement

Spawning conservation requirements for Atlantic salmon are set as numbers of adults required to fully utilize available habitat. It is assumed that populations attain this requirement if egg deposition by spawning adults reaches or surpasses 2.4 eggs per $m^2$ of non-tidal, non-impounded river area. The conservation requirement concept was developed for rivers with wild salmon runs, and may be less applicable to PEI streams where most salmon are of hatchery origin.

Conservation requirements are calculated from fecundities and sex ratios of Morell salmon reported by Davidson and Bielak (1992) and Cairns et al. (1995). River areas for the Mill, Dunk, West, Morell, and Valleyfield Rivers are derived from habitat surveys in which the width of the wetted area was measured in cross-stream transects (Davidson and Angus 1994, Cairns et al. 1995). The Morell contains 237,176 $m^2$, of which 74,727 $m^2$ (32%) is upstream from Leards Pond (Table 3).

Spawning requirements are calculated in Table 3 according to the method below (Morell River data are used as an example). Note that some figures do not sum exactly because of rounding.

i) Number of eggs required for the river = river area x 2.4 eggs /$m^2$. [237,176 x 2.4 = 569,222]
ii) Number of large females required to produce these eggs = number of eggs/fecundity. It is assumed that all eggs come from large females. This assumption is justified because large females produce more eggs than small females, and because most small salmon are males. [569,222/4963 = 115].
iii) Number of large males required = number of large females x (100 minus percent of large salmon that are female)/percent of large salmon that are female. This gives the number of large males that would accompany the required number of large females, given the sex ratio measured in previous years. [115 x (100 - 72.1)/72.1 = 44].
iv) Total number of large salmon required = number of large female salmon required + number of large male salmon required. [115 + 44 = 159].
v) Male deficit = number of large females required - number of large males required. This gives the number of additional males required to provide each spawning female with a mate. [115 - 44 = 70].
vi) Total number of small salmon required, if small salmon meet the male deficit = 100 x male deficit/percent of small salmon that are male. [100 x 70/82.5 = 85].

The Morell requirements were estimated at 159 large salmon and 85 small salmon, including 50 large and 27 small salmon above Leards Pond. Total conservation requirements for the five rivers are 537 large salmon and 288 small salmon.

In addition to the Morell's natural spawning needs, there is a requirement for about 20 large salmon and 50 small salmon for use as broodstock at the Cardigan Salmonid Enhancement Centre. These fish are collected from the trap at Leards Pond.

## Fisheries data

### Stocking

Most salmon stocked on PEI are cultured through a process known as semi-natural rearing. Fish are hatched at the Cardigan Salmonid Enhancement Centre and are placed in Mooneys, Profitts, or Gilberts Ponds, or in the cages in Munns Pond in the spring following their year of hatching. Stocked fish are marked by removal of the adipose fin. Mooneys, Profitts, and Gilberts are artificial impoundments which have barriers at their inlets and outlets to retain fish. The fish are fed artificial food in these ponds, but they are exposed to natural mammalian and avian predation. Natural food is also available. The fish are released into streams as age 2+ smolts. Juvenile salmon raised in Profitts Pond suffered complete kills in 1995 and 1996. In 1995 the salmon died after a tank carrying potato fungicide overturned and its contents made their way into the pond. In 1996, the fish died during or after a rainfall which occurred during a period of intensive pesticide application in the pond's watershed.

At Profitts Pond, the smolts are collected by lowering the pond level and concentrating the fish with seines. At Mooneys, the fish have been traditionally collected by lowering the pond and trapping them as they leave. In 1995 some fish were trapped and others were allowed to enter the West Branch of the Morell on their own accord (details in Cairns et al. 1997). In 1996, the stoplogs at Mooneys were removed on 27 April, permitting the fish to descend the river at will without being counted.

Numbers of juvenile salmon stocked in major PEI streams in 1996 are given in Tables 4 and 5. As exit counts at Mooneys were not conducted in 1996, releases of juvenile salmon into the Morell were estimated by applying a 65% survival rate (R. Angus, pers. comm.) to the 72,397 1+ parr placed in the pond in June 1995, and adjusting for removals to other rivers. This yields an estimated release of 42,691 fish.

The Mill River was stocked in 1996 with 1065 2+ smolts, which had been placed as 1+ parr in Profitts Pond after the 1995 kill (Table 5). The Dunk River received 11,350 of these fish. The West River received 6,971 2+ fish from Munns and Mooneys Pond, and the Valleyfield received 15,305, mostly 2+ smolts, from semi-natural ponds and the Cardigan SEC. The Valleyfield stockings included fish from Gilberts Pond, which has no counting facility at its outlet. Hence stockings from that site were estimated by applying the 65% survival rate to the fish released in the pond in the previous year (Table 5).

### Angler surveys

Prince Edward Island salmon angling catch and effort have been estimated by a mail-out survey which covered the 1994 fishing year (Cairns 1996), and by licence stub surveys which covered the 1995 and 1996 seasons. The 1996 licence survey stub was similar to the one used in the preceding year, except that provision for recording hatchery/wild status of catches was discontinued (Fig. 4). On 13-17 December 1996, reminder cards were mailed to licence-holders from whom cards had not been received. Twenty-three additional cards were mailed on 9-15 January after the final licence books were returned from vendors. The reminder cards had space for daily records as well as seasonal summaries (Fig. 4), and also had business reply addresses. No provision was made for postage for reminder cards sent to US addresses. Reminder cards were numbered with the licence serial number to allow

detection of cases where both the stub and reminder were returned.

Mailing, return, and participation statistics are given in Table 6. Two hundred fourteen usable replies were obtained from 697 licence-holders (30.7%). Among respondents 80.4% reported fishing salmon in 1996. Survey results indicated a PEI-wide salmon fishing effort of 6,478 rod-days in 1996, including 4,156 rod-days on the Morell (Table 7). The survey estimated retained sport catches of 397 small salmon on the Morell, 26 on the Mill, 7 on the Trout, 3 on the Dunk, 62 on the West, and 36 in the Valleyfield.

Native fishing reports

The Prince Edward Island Native Council reported that its members harvested 17 small salmon from the pool at the outlet to Mooneys Pond in August 1996.

## Research data

Morell adult movements

Upstream movements of Atlantic salmon have been monitored at the Leards Pond fishway since 1981 (Table 8, Fig. 5). Numbers rose sharply in the mid 1980s, reaching a peak of 1,481 fish in 1988. Counts fluctuated before falling to 65 fish in 1994, which reflects a weak stocked cohort due to a die-off in Mooneys Pond in 1992. Counts since 1994 have shown a modest recovery.

The Morell salmon run, as shown by Leards counts, has two seasonal peaks (Fig. 6). The bulk of the fish enter in late June and July, but a smaller fall run occurs in September-October. Run timing in 1996 was similar to that of the long-term mean. Some fish may enter Leards Pond before trapping starts in some years, and thus escape counting. However, daily counts were zero or low at the beginning of trap operations in nearly all years, and do not increase substantially until mid-June (Fig. 6). This suggests that the number of fish that avoid counting by entering Leards before the trap opens is low.

In keeping with previous years, most salmon recorded at Leards were small (88%) and of hatchery origin (86%).

In the 1994, only two female salmon were released from the Leards fishway into the pond, but redd and electrofishing surveys and conversations with anglers indicated substantial salmon activity upstream from the pond. This suggested that fish were circumventing the trap and entering the pond without being counted (Cairns et al. 1996). However, thorough searches in both 1995 and 1996 could locate no gaps or passages either in the bypass, which is blocked by two fish fences, or the fishway.

In 1996, a mark-recapture experiment was conducted to determine how many salmon were evading the Leards counting facility. All salmon placed in the pond were dye-marked with alcian blue, using a Madajet needleless injector. Dots were applied to the lower flank close to the tail, in patterns which identified the month of marking. Fish processed after 1 August were also given caudal hole-punches.

Salmon commonly congregate in the pool below Mooneys Pond, whose exit is blocked during the summer and fall. Mark-recapture estimates were made of fish entering Leards Pond by recaptures at the Mooneys outlet pool by native harvesters in August, and by dipnetting and seining in October. In the first October session, when fish were captured in the culvert and well under the dam, V-notches were applied to the tail. Recaptures in the second session, when fish were captured by seining, allowed an estimate of the pool's population.

All marked salmon captured at Mooneys in October had single dots on the left or right flanks, indicating that they were processed at Leards from 31 May to 31 July. This suggests that fish passing Leards in August and later did not ascend to Mooneys in 1996. Hence mark-recapture estimates are for fish passing through Leards prior to 1 August.

All dots on recaptured fish were clear and distinct. This suggests that mark loss was not a problem, because if dots faded with time a gradation from clear to faint should have been seen.

Mark-recapture analysis was performed on the pooled sample of small and large fish because recovery rates of marked fish of the two groups were similar (23 and 25% respectively, Table 9) and because recaptures of large fish were not sufficiently numerous for analysis.

Mark-recapture statistics are presented in Table 9. Of eight fish captured on 2 October and V-notched, four were recaptured among the 99 taken on 5 October. Leards counts in May-July totaled 207 fish, but 60 of these were removed for broodstock. Of the 147 fish which were dye-marked and placed in Leards Pond, four were recovered among the 17 fish harvested by natives in August. Thirty-four of the 103 fish captured in October had dye-marks (33%).

Populations were estimated as the median of Bayesian probability distributions (Table 9, Fig. 7)(Gazey and Staley 1986). The population of the pool below Mooneys was estimated as 285 fish (Table 9). However, this number could be upwardly biased. Mark-recapture theory requires that marked fish be equally available for capture, relative to other animals in the population, during the first and second sampling session. The first marking session was in the culvert and well below the dam, while the second was in the lower part of the pool where a clear bottom allowed unrestricted seining. It seems plausible that fish marked at the culvert and well might tend to hold in the upper area of the pool. This would lower their risk of recapture in the second sampling session, and upwardly bias the population estimate.

Estimates of salmon entering Leards Pond in May-July were 868 (95% CI 368-2558) and 458 (95% CI 354-622) from the native and October recaptures, respectively. Since the October estimate was based on a larger sample, it will be retained as the best estimate of the number of salmon entering Leards Pond.

The number of salmon arriving at Leards Dam and attempting to ascend into the pond is taken as the sum

of the mark-recapture estimate and broodstock removals (458+60=518, Table 9). Leards capture efficiency, based on total counts divided by total estimated arrivals, was 0.400. Application of this efficiency to salmon arriving after 31 July yields an estimate of 105 fish. Total estimates for the season are 623 fish arriving at Leards, of which 563 entered the Pond.

Scales were taken from nine small salmon, of which three had dye marks. Ring patterns past the sea-entry mark were similar in all scales, and all showed one sea winter. This indicates that fish in the sample were not wintering in Leards Pond. Of six scales which could be read for river age, three were read as two river years, two as three river year, and one as four river years (Table 9).

Salmon appear to have been able to circumvent the counting facility at Leards in substantial numbers at least since 1994. Application of the Leards trap efficiency measured in 1996 to the period 1994-1996 permits an estimate of total arrivals at Leards for this period (Table 8, Fig. 5). However, comparisons must be made with caution because there is no basis for estimating trap efficiencies in earlier years.

Movements in other rivers

A counting fence was operated at Phantom Lane on the Valleyfield River in 1996 (Table 10). Eighty-eight small and eight large salmon were trapped there, the highest numbers on record.

Redd surveys

Redd counts in PEI salmon rivers are presented in Table 11 and Fig. 8. Redd counts in the Morell, supplied by D.L. Guignion and R. MacFarlane, totaled 438, of which 308 (70%) were above Leards Pond. Trout River counts, furnished by D. Biggar and C. Crane, totaled 42 redds. Both Morell and Trout River counts were in the mid-range of results from earlier years.

In 1996, redd surveys were conducted in several other streams not traditionally known as salmon rivers. Counters recorded 49 redds on Bristol Creek, 73 on the Midgell, and 30 on the St Peters, and 88 on the Naufrage.

Morell electrofishing

Densities of juvenile salmon were measured by electrofishing at 14 sites in the Morell in August-September 1996 (Table 12, Figs. 2 and 9). At five survey sites, crews equipped with lip seines conducted three sweeps within stream sections that were bounded by barrier nets. Single-sweep surveys without barrier nets and without lip seines were conducted at nine sites. Densities in triple-sweep sites were estimated by the Zippin method (Zippin 1958). Densities in single-sweep sites were estimated from the capture efficiency of Sweep 1 as measured in the sites with multiple sweeps (Table 12). Adjustments for the absence of lip seines in single-sweep surveys were not made because of lack of multiple-sweep trials without lip seines.

Densities ranged from 0 at Gill Road, which is above Mooneys Pond and therefore inaccessible to adult salmon, to 31.6 fish $m^{-2}$ at Leards Bridge (Table 12). The recent series of Morell electrofishing sites are in the same areas as four sites measured in 1975 by Ducharme (1977), and closely overlap with six sites surveyed by R. Gray and K. Davidson in 1984-1985 (Cairns et al. 1996) (Table 13, Fig. 9). Extrapolation of measured densities to river wetted area permits estimation of total populations of juvenile salmon (Table 13). Total population in August-September 1996 was estimated as 32,197 juvenile salmon. Estimates for the Main Branch showed irregular fluctuations over the time series, but West-South and East Branches showed relatively constant numbers, except for a sharp peak in August-September 1994 (Fig. 10). This peak was largely due to high numbers at Kennys Hole and at Cranes.

Length-frequency distributions of fish taken during electrofishing vary among years in their modal patterns (Fig. 11). In 1984 and 1994, distributions were distinctly bi-modal, suggesting the presence of only two year classes (0+ and 1+). In 1996, three distinct modes were present, suggesting 0+, 1+, and 2+ cohorts. In 1995 the distribution was bi-modal, but many intermediate values were present, suggesting fluctuation in growth rate, or the presence of some 2+ fish.

Age composition of unclipped fish captured at the Indian Bridge smolt trap in 1995 (Cairns et al. 1997) and 1996 is as follows:

| Age | 1995 | | 1996 | |
|---|---|---|---|---|
| | Number of fish | Percent | Number of fish | Percent |
| 1+ | 0 | 0 | 1 | 3 |
| 2 or 2+ | 8 | 67 | 34 | 97 |
| 3 | 2 | 17 | 0 | 0 |
| 4 | 2 | 17 | 0 | 0 |

In this summation, 2+ fish are those which are at least 2 years old. The presence of fish older than 2 years in the 1995 wild smolt run calls into question the simple two-cohort age structure inferred by the 1994 length frequency distribution.

In 1975, Ducharme (1977) collected 35 scale samples from the Morell. Thirty-four were age 1+ and one was 2+. This sample is notable for the absence of the 0+ group. This absence, and the variable length-frequency patterns from more recent electrofishing surveys, implies that growth rates and age structures of young salmon in the Morell vary among years.

Table 13 presents population estimates partitioned among age classes on the basis of length-frequencies. However, it must be noted that such a procedure, in the absence of full aging data, carries substantial uncertainty. In particular, fish classified as 1+ probably include some 2+ animals. This analysis yielded estimates of 24,312 0+, 7,885 1+, and 9,411 2+ juvenile salmon in the Morell in 1996.

Morell smolt movements

A smolt fence was operated on the Morell River from 22 April to 19 May 1996, at a site about 500 m upstream

from the location of the 1995 smolt fence (Cairns et al. 1997). The 1996 fence was constructed of electrical conduit set in channel iron, and stretched completely across the river. There were no major snow or rain falls during the period of operation, and no washouts were experienced.

A large influx of descending smolts began on 28 April, the day after the removal of stoplogs barring the exit of cultured smolts from Mooneys Pond (Fig. 12). Substantial smolt movements continued until mid-May. Movements of wild smolts closely paralleled those of hatchery fish (Fig. 12). Length-frequencies of clipped and unclipped smolts are presented in Fig. 13.

The proportion of unclipped fish which were of hatchery origin was calculated from dorsal fin examinations at Indian Bridge and at Mooneys Pond (Mooneys data supplied by K. Davidson). It is assumed that dorsal fins of wild fish are uneroded. Calculations are as follows:

| | |
|---|---|
| Percent of smolts at Mooneys Pond that had frayed dorsal fins | 36.0 |
| Fin examination, unclipped fish at Indian Bridge: | |
| Fish examined | 571 |
| Fish with frayed dorsal fins | 71 |
| Percent with frayed dorsal fins | 12.4 |
| Percent of unclipped fish at Indian Bridge that are of hatchery origin (1/0.36)*0.124 | 34.5 |

A displacement experiment was conducted to determine the capture efficiency of the trap (text table below). On five occasions, small notches or cuts were applied to tails of fish captured at the trap. These fish were then placed in a plastic fish pan and canoed 0.3 to 1 km upstream, where they were released. Results were:

| Experiment | Number of fish displaced | Number of fish recovered | Percent of fish recovered |
|---|---|---|---|
| 1 | 116 | 31 | 26.7 |
| 2 | 59 | 2 | 3.4 |
| 3 | 70 | 7 | 10.0 |
| 4 | 134 | 94 | 70.1 |
| 5 | 69 | 22 | 31.9 |
| Total | 448 | 156 | 34.8 |

Recovery rates represent a minimum estimate of the trap's capture efficiency, as some displaced fish may not have continued their descent of the river after they were handled and displaced.

The table below gives direct counts of clipped and unclipped fish, estimates of hatchery and wild fish movements based on the calculated rate at which hatchery fish escaped clipping, and adjusted total movements assuming that trap efficiency is the same as the overall recovery rate from the displacement experiment.

| | |
|---|---|
| Smolts, from direct counts | |
| Clipped | 16,149 |
| Unclipped | 2,591 |
| Hatchery | 17,044 |
| Wild | 1,696 |
| Total | 18,740 |
| Smolts - adjusted by displacement recapture rate | |
| Clipped | 46,405 |
| Unclipped | 7,445 |
| Hatchery | 48,977 |
| Wild | 4,874 |
| Total | 53,851 |
| Black salmon | |
| Clipped | 10 |
| Unclipped | 13 |
| Total | 23 |

This analysis indicates that the 1996 hatchery smolt exodus was between 17,044 (direct count adjusted for non-clipping rate) and 48,977 (direct count adjusted for non-clipping rate, and assuming the minimum trapping efficiency). The estimate of juvenile releases derived from applying a 65% survival rate to 1+ parr placed in Mooneys Pond in 1995 (42,691, Table 4) lies between these figures.

### Estimation of stock parameters

In 1995, a mark-recapture experiment was conducted in the Morell in which fish tagged at a trap below head of tide were recovered at the Leards trap. The run-size estimate from this procedure was 1550 fish. Run sizes for 1994 and 1996 can be calculated from the 1995 estimate by assuming constancy during 1994-1996 in Leards trap efficiency and in the proportion of the Morell's total run that ascended the West Branch to Leards. In the table below, run sizes for 1994 and 1996 are calculated from the ratios of Leards counts for each of these years to 1995 Leards counts (Table 8, Table 14). Size and age composition of these estimates is based on that found at Leards for the year in question. All of these assumptions are untested and the resulting estimates must be considered rough approximations only. In particular, the proportion of returning salmon that ascend Leards fishway is likely a function of the proportion of smolts that were stocked above Leards in the previous year, which varied from year to year (Table 4).

| | 1994 | 1995 | 1996 |
|---|---|---|---|
| Small hatchery | 216 | 1326 | 1450 |
| Small wild | 62 | 108 | 239 |
| Large hatchery | 208 | 77 | 200 |
| Large wild | 15 | 39 | 31 |
| Total | 501 | 1550 | 1920 |

Total run of the Valleyfield River is taken as the fish fence count of 75 small and 8 large salmon (Table 10). Fish counts were not made in PEI's other salmon rivers in 1996.

### Assessment results

Return rates

The return rates of stocked Atlantic salmon to rivers where they were released can be calculated by tracing cohorts through time (Table 15). This analysis assumes that fish stocked as 0+ and 1+ parr leave the river as 2+ smolts, that fish stocked as 1+ smolts, 2+ parr, and 2+

smolts leave the river immediately after release, that small salmon have spent one winter at sea, and that large salmon have spent two winters at sea. The analysis also assumes that no fish return to the river a second time.

Return rates for fish stocked above Leards Dam and returning as small salmon ranged from 0.1% to 8.4% (Table 15, Fig. 14). In 1995, an estimated 7,822 semi-naturally reared 2+ smolts were stocked into the Morell above Leards. The raw return rate based on direct Leards counts was 2.4%. The adjusted return rate, based on Leards counts corrected for trapping efficiency, was 6.0% (Table 15). This return rate is second only to that obtained in 1987 (Fig. 14). However, it must be emphasized that 1995 releases, upon which this return rate is based, are known only approximately (Cairns et al. 1997).

Return rates for the entire Morell were calculated from total releases in the river and estimates of run size based on the 1995 mark-recapture experiment. Estimated returns of small salmon were 1.0% in 1994, when the run derived from 1+ parr and growth-accelerated 1+ smolts, and 5.1% in 1995. In 1996 small salmon return rate was calculated as 9.3%, but this estimate may contain substantial error because of uncertainty in the 1995 release numbers.

Return rates derived from the Valleyfield fence were 0.25% in 1996 (Table 15). This stream is stocked mostly with 0+ and 1+ parr, which presumably suffer higher river mortality than fish released as smolts. Return rates that ignore these fish, and use only stocking numbers for 2+ smolts, were 3.3% in 1995 and 0.5% in 1996.

Fig. 15 plots the number of adults trapped at Leards against the number of juveniles released above Leards during the previous year. In general, fish raised semi-naturally showed better return rates than those raised entirely in a hatchery (see also Fig. 14). The plot shows a curvilinear pattern, with stockings of intermediate size yielding the greatest returns. Use of a correction factor for trap efficiency in 1994-1996 does not change the overall shape of the plot. The scattergram's curvilinear form does not demonstrate a causal relation, because return rate is subject to marine survival which varies widely. However, Fig. 15 makes it clear that increasing stocking numbers does not necessarily mean that more fish will return.

The number of fish stocked above Leards shows no clear relation with redd counts in the year of return (Table 16, Fig. 16). The number of salmon released above Leards in 1990-1996 was not significantly related to redd counts in the same year (Fig. 17). This result must be viewed with caution, because it covers a period when the efficiency of Leards trap may have been changing.

The number of redds counted above Leards has exceeded 50% of the river total since 1992 (Table 11). In 1995, redds counted above Leards composed 61% of the river total, whereas a mark-recapture analysis indicated that only 28% of the Morell run ascended Leards (Tables 19 and 20). The discrepancy between these percentages suggests that either the redd counts or the proportion ascending Leards might be in error. The same crews have been counting Morell redds since 1990, and feel confident that they can locate most salmon redds in the river and reliably distinguish them from trout redds (D.L. Guignion pers. comm.). In the absence of information on the number and variability of redds produced per spawning salmon, the discrepancy of percentages noted above cannot be resolved, except to say that it underlines the uncertainty inherent in both data sets.

Population estimates based on electrofishing data (Table 13) permit the calculation of return rates of wild fish. Population estimates for the 1983-1985 cohorts above Leards Pond were zero or very low, and subsequent returns to Leards included only a handful of wild fish (Table 17). Returns from the 23,058 1+ parr estimated above Leards in 1994 were calculated as 0.134% based on direct Leards counts, and 0.338% based on adjusted Leards counts. Return rate for the entire Morell from the estimated population of 22,765 1+ parr in August-September 1994 was 1.05%.

Exploitation rates

Exploitation rates of Morell salmon were estimated for 1995 as the quotient of the retained catch from the stub survey (Table 6) and the run estimate from the mark-recapture experiment. Calculated exploitation rate was 34.0% in 1994, 34.7% in 1995, and 23.5% in 1996 (Table 18). Exploitation rates based on fishway counts on the Valleyfield were 33.3, 27.6, and 48.0% in the three years, respectively.

Conservation requirements

Potential spawning by Atlantic salmon released from the Leards trap rose sharply in the mid-1980s but fell again in the 1990s (Table 19, Fig. 18). However, application of the correction factor to Leards counts for 1993-1996 boosted estimated egg deposition to the mid-range of the time series. Egg deposition derived from adjusted Leards counts was 82% of assumed conservation requirement in 1994, but rose to 160% in 1995 and 243% in 1996. These depositions are not adjusted for angling harvest, as harvest estimates specific to the Morell above Leards are not available.

Total spawning for the river was estimated for 1994-1996 using the 1995 mark-recapture run estimate adjusted for Leards counts. Spawning escapement after sport and native harvests produced estimated egg depositions equivalent to 158, 166, and 270% of spawning requirements in 1994-1996, respectively (Table 20). There are substantial uncertainties in these estimates, but it appears safe to say that 1996 egg deposition at least met conservation requirements and likely exceeded 1995 depositions.

Table 20 also presents returns, escapements, and potential egg depositions in the Mill, Dunk, West, and Valleyfield Rivers. None of these rivers has met conservation requirements in years for which data are available. The best result was 70% of conservation

requirement in the Mill River in 1995. Despite its record run, the Valleyfield attained only 16% of requirements in 1996.

### Ecological considerations

Salmon are vulnerable to high water temperatures in warm summers. The summer of 1996 was cooler than the previous two, and water temperatures did not pose problems for salmon (Fig. 19). Caissie (1997) provides further details of 1996 hydrological conditions.

### Forecasts/prospects

The Morell salmon run consists of wild and hatchery-reared fish, with the latter predominating. This paper has reviewed data on electrofishing densities and stocking rates in relation to returns of wild and hatchery fish, respectively. However, no relations have emerged that have predictive value for future returns. There is therefore no formal basis for predicting returns in 1997. Clearly, any major decline in wild juvenile populations or stocking might portend lower returns. As no such decline occurred in 1996, the most likely prospect is that returns will be similar to those of 1996.

### Management considerations

Despite intensive stocking and habitat enhancement since the early 1980s, the Morell River supports only modest runs of wild salmon. Potential wild runs under various scenarios are calculated in Table 21. The estimated run in 1996 was 239 small and 31 large salmon. This estimate for small wild fish was 57% of recent estimated harvests, which means that the wild run could not meet angler expectations even if all fish were taken. In the absence of exploitation, the estimated 1996 run would attain only 43% of conservation requirements.

Wild runs projected from smolt fence estimates and electrofishing densities ranged from 11 to 85% of conservation requirements.

This analysis suggests that, under current conditions, wild salmon production on the Morell cannot be expected to meet angler expectations and conservation requirements.

The mean estimated Morell harvest for 1995-1996 was 423 small salmon. The wild run needed to supply this harvest can be calculated by assuming that all eggs are deposited by large females and that small male salmon fill the male deficit of large salmon. A run of 530 small and 147 large salmon would just meet conservation requirements and produce a harvestable surplus of 451 small salmon under the above circumstances. This run is 2.5 times as large as that estimated for 1996.

Factors limiting wild salmon production on Prince Edward Island are unknown, but presumably involve quality of physical habitat. Most rivers on Prince Edward Island have high silt loading which is deleterious to salmonid survival and reproduction. Siltation threats are currently increasing due to the expansion of row crop agriculture. In addition, salmonids face risks from intensive use of pesticides, a risk which was highlighted in 1996 by the second complete kill in two years of juvenile salmon in Profitts Pond. The degradation of Prince Edward Island fish habitat by siltation and pesticide contamination negates much of the enhancement work undertaken by volunteer groups and government agencies. If these pollutants could be kept in check, rivers would have a better chance of building runs of wild salmon that would satisfy angler demands and meet conservation requirements.

It is clear that the Morell and other PEI rivers will continue to rely on stocking to supply their salmon runs. For this reason, and because escapement on the Morell exceeds currently defined conservation requirements, no change to current management is recommended.

### Research recommendations

The method of assessing the Morell River salmon run should be reviewed. The 1995 mark-recapture experiment provided the only basis for estimating the Morell's total run, but this work will not likely be repeated because of its cost and a perceived risk of delaying upstream migration. The mark-recapture experiment at Leards and Mooneys in 1996 provided a means of estimating numbers of salmon entering Leards Pond, but comparison of adjusted Leards numbers with earlier figures is problematic because trapping efficiencies in earlier years are not known. Alternative approaches that would permit estimates of total run should be investigated. This might include seining or a partial fence on the lower river, with recaptures at Leards or Mooneys. The assessment scheme must take into account changing priorities and interests as government fish hatcheries are divested to private groups.

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Table 1
Atlantic salmon sport catches on the Morell River, 1955-1996.

| Year | Salmon caught and retained | | | Salmon caught and released | | | Fishing effort | Licences |
|---|---|---|---|---|---|---|---|---|
| | Small | Large | Total | Small | Large | Total | (rod-days) | issued on PEI |
| 1955[a] | | | 21 | | | | 18 | |
| 1956 | | | 29 | | | | 87 | |
| 1957 | | | 3 | | | | 52 | |
| 1958 | | | 9 | | | | 52 | |
| 1959 | | | 4 | | | | 34 | |
| 1960 | | | 4 | | | | 44 | |
| 1961 | | | 15 | | | | 45 | |
| 1962 | | | 13 | | | | 50 | |
| 1963 | | | 51 | | | | 280 | |
| 1964 | | | 12 | | | | 46 | |
| 1965 | | | 12 | | | | 115 | |
| 1966 | | | 10 | | | | N/A | |
| 1967 | | | 26 | | | | 206 | |
| 1968 | | | 10 | | | | 192 | |
| 1969 | | | 12 | | | | 214 | |
| 1970 | 0 | 13 | 13 | | | | 204 | |
| 1971 | 0 | 0 | 0 | | | | 83 | |
| 1972 | 0 | 7 | 7 | | | | 138 | |
| 1973 | 2 | 0 | 2 | | | | 168 | |
| 1974 | 0 | 2 | 2 | | | | 78 | |
| 1975 | 0 | 0 | 0 | | | | 0 | |
| 1976 | 6 | 1 | 7 | | | | 250 | |
| 1977 | 0 | 0 | 0 | | | | 105 | |
| 1978 | 0 | 0 | 0 | | | | 60 | |
| 1979 | 1 | 2 | 3 | | | | 54 | |
| 1980 | 5 | 1 | 6 | | | | 119 | |
| 1981 | 108 | 4 | 112 | | | | 914 | |
| 1982 | 73 | 8 | 81 | | | | 2,088 | |
| 1983 | 7 | 2 | 9 | | | | 686 | 321 |
| 1984 | 7 | 0 | 7 | | | | 675 | 68 |
| 1985 | 47 | N/A | 47 | | | | 1,007 | 117 |
| 1986 | 236 | N/A | 236 | | | | 2,725 | 279 |
| 1987 | 476 | N/A | 476 | | | | N/A | 461 |
| 1988 | 643 | N/A | 643 | | | | 4,994 | 719 |
| 1989 | 167 | N/A | 167 | | | | 4,506 | 646 |
| 1990 | 768 | N/A | 768 | | | | 9,000 | 793 |
| 1991[b] | 657 | N/A | 657 | 1,033 | 164 | 1,197 | 11,552 | 716 |
| 1992 | 781 | N/A | 781 | | | 1,044 | 11,700 | 928 |
| 1993 | N/A | N/A | N/A | | | | N/A | 829 |
| 1994 | 89 | 0 | 89 | 111 | 99 | 210 | 4,911 | 587 |
| 1995[c] | 469 | 1 | 470 | 146 | 95 | 241 | 5,073 | 633 |
| 1996 | 414 | 0 | 414 | 270 | 150 | 420 | 4,156 | 697 |

[a]Figures for 1955-1990 are estimates by DFO fisheries officers (Smith 1981; O'Neil and Swetnam 1984, 1991; Swetnam and O'Neil 1985, 1985; Bielak et al. 1991).

[b]Figures for 1991, 1992, and 1994 are from angler mail-out surveys (MacFarlane and Guignion 1992, 1993; Cairns 1996).

[c]Figures for 1995-1996 are angler harvest estimated from licence stub surveys, plus native harvest.

Table 2
Fishing seasons on the Morell River, 1996

| Area | Includes sites | Period[a] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 15 Apr-28 Apr | 29 Apr-12 May[b] | 9 May-31 May | 1 Jun-15 Sep | 16 Sep-14 Oct | 15 Oct-31 Oct | 1 Nov-30 Nov |
| From river mouth to just above MacKays | Andersons, Morell, MacKays | T | T | T | T,S | - | - | - |
| From just above MacKays to Forks | Indian Bridge, Mooneys Bridge, Grants | T | - | T | T,S;ff | S;ff,bo | S;ff,bo | - |
| West Branch between the Forks and just below Leards Pond | Leard's Bridge, Landing Pool | T | - | T | T,S;ff | S;ff,bo | - | - |
| Leard's Pond | Leard's Pond | T | - | T | T,S;ff | S;ff,bo | S;ff,bo | S;ff,bo |
| West Branch above Leards Pond | West Branch stream crossings on Peakes Road (Route 320), Pisquid Pond | T | - | T | T,S | - | - | - |
| East Branch between the Forks and Hazelgreen Road (Route 329) | Cranes | T | - | T | T,S;ff | S;ff;bo | - | - |
| East Branch above Hazelgreen Road | Kneabones, Everglades, Martinvale | T | T | T | T,S | - | - | - |

[a]T = open season for trout, S = open season for Atlantic salmon, ff = fly fishing only, bo = barbless hooks only
[b]Closed period for the release of stocked salmon smolts

Table 3
Number of salmon required to produce 2.4 eggs per $m^2$ of non-tidal, non-impounded water in PEI salmon rivers, based on the biological characteristics of Morell River salmon.

| | Morell | Morell above Leard's | Mill | Dunk | West | Valleyfield | Total |
|---|---|---|---|---|---|---|---|
| River area ($m^2$)[a] | 237,176 | 74,727 | 58,300 | 193,078 | 184,500 | 127,500 | 800,554 |
| Eggs required at 2.4 eggs per $m^2$ | 569,222 | 179,345 | 139,920 | 463,387 | 442,800 | 306,000 | 1,921,330 |
| Mean fecundity[b] | 4,963 | 4,963 | 4,963 | 4,963 | 4,963 | 4,963 | |
| Number of large female salmon required | 115 | 36 | 28 | 93 | 89 | 62 | 387 |
| Percent of large salmon that are female[c] | 72 | 72 | 72 | 72 | 72 | 72 | 361 |
| Number of large male salmon required | 44 | 14 | 11 | 36 | 35 | 24 | 150 |
| Total number of large salmon required | 159 | 50 | 39 | 129 | 124 | 86 | 537 |
| Male deficit (number of females - number of males) | 70 | 22 | 17 | 57 | 55 | 38 | 237 |
| Percent of small salmon that are male[c] | 83 | 83 | 83 | 83 | 83 | 83 | 413 |
| Total number of small salmon required, if small salmon meet the male deficit | 85 | 27 | 21 | 69 | 66 | 46 | 288 |
| Total number of salmon required | 244 | 77 | 60 | 199 | 190 | 131 | 825 |

[a]River area for the Valleyfield from Davidson and Angus 1994; other river areas as compiled by Cairns et al. 1995
[b]From Davidson and Bielak 1992
[c]Sex ratios from Davidson and Bielak 1992 and Cairns et al. 1995

Table 4
Numbers of juvenile Atlantic salmon stocked in the Morell River, 1990-1996, and their stages at release. (Stocking numbers for 1978-1989 are given by Cairns et al. 1996.)

| Year | Genetic stock | Rearing location | Numbers released and location[ab] | | | | Total released |
|---|---|---|---|---|---|---|---|
| | | | Parr | | Smolt | | |
| | | | 1+ | 2+ | 1+ | 2+ | |
| 1990 | Morell mixed | Mooneys Pond | | 398 Mo | | 48,475 Mo | 59,810 |
| | | Profitts Pond | | 681 Gr | | 10,256 Gr | |
| 1991 | Morell mixed | Mooneys Pond | | 18 Mo | | 24,638 Mo | 36,496 |
| | | | | 3 Ma | | 1,997 Ma | |
| | | | | 2,032 Gr | | 7,808 Gr | |
| 1992 | Morell mixed | Mooneys Pond | 2,200[c] Mo | 339 Mo | | 35,524 Mo | 47,822 |
| | | | | 29 Pe | | 2,342 Pe | |
| | | | | 1,483 Gr | | 2,468 Ma | |
| | | | | | | 3,437 Gr | |
| 1993 | Morell mixed | Cardigan SEC | | | 14,372 Mo | | 19,379 |
| | | | | | 5,007 Pe | | |
| 1994 | Morell mixed | Mooneys Pond | | 136[d] Mo | | 10,814[d] Mo | 26,000 |
| | | | | 7 Ma | | 4,360 Ma | |
| | | | | 594 Gr | | 10,089 Gr | |
| 1995 | Morell mixed | Mooneys Pond[e] | | 1,270 Mo | | 6,552 Mo | 15,568 |
| | | | | 503 Ca | | 2,230 Ca | |
| | | | | 89 Gr | | 4,924 Gr | |
| 1996 | Morell mixed | Mooneys Pond[f] | | 5,106 Mo | | 37,585 Mo | 42,691 |

[a]Release locations are Mooneys Pond outlet (Mo), Peakes Road Bridge (Pe), Old Cardigan Road (Ca), MacAuleys (Ma), and Grants Bridge (Gr)

[b]All fish were released in April or May except 1+ parr which were released in the fall.

[c]These fish were the survivors of a die-off of salmon in Mooneys Pond in the summer of 1992. Numbers are approximate.

[d]Numbers given are actual counts + 40% in order to account for fish released without counting.

[e]Includes fish counted at the outlet to Mooneys Pond, and estimations derived from counts at the Indian Bridge smolt fence (Cairns et al. 1997).

[f]Fish were released into the outlet to Mooneys Pond without counting. Numbers are based on a 65% survival rate of the 72,397 1+ parr placed in the pond in June 1995, removals to other stocking sites, and the smolt:parr ratio recorded in 1995.

Table 5

Stocking dates and numbers of juvenile Atlantic salmon stocked in the Mill, Dunk, West, Midgell, and Valleyfield Rivers, 1990-1996. (Stocking numbers for 1985-1989 are given in Cairns et al. 1996).

| Year | Rearing location | Stage stocked | Date stocked | Numbers stocked | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Mill River | Dunk River | West River | Midgell River | Valleyfield River |
| 1990 | Cardigan SEC | 0+ parr | 16 Nov-10 Dec | 0 | 0 | 0 | 0 | 89,003 |
| | | 1+ smolt | 27-30 May | 0 | 0 | 0 | 0 | 738 |
| | Profitts Pond | 2+ parr | 4-8 May | 25 | 0 | 0 | 0 | 0 |
| | | 2+ smolt | 4-8 May | 3,082 | 0 | 0 | 0 | 0 |
| 1991 | Cardigan SEC | 0+ parr | 13-15 Nov | 0 | 0 | 0 | 0 | 55,723 |
| | | 0+ parr | 20-23 Nov | 0 | 0 | 50,750 | 0 | 0 |
| | | 1+ smolt | 7 May-5 June | 0 | 0 | 0 | 0 | 5,259 |
| | Profitts Pond | 2+ parr | 6-10 May | 159 | 0 | 0 | 0 | 0 |
| | | 2+ smolt | 6-10 May | 1,873 | 717 | 0 | 0 | 0 |
| | Mooneys Pond | 2+ smolt | 10-11 May | 0 | 1,300 | 0 | 0 | 0 |
| 1992 | Cardigan SEC | 0+ parr | 12 Nov | 0 | 0 | 0 | 0 | 32,494 |
| | | 2+ smolt | 13-16 May | 0 | 0 | 0 | 0 | 1,693 |
| | Profitts Pond | 2+ parr | 4-5 May | 169 | 0 | 0 | 0 | 0 |
| | | 2+ smolt | 4-5 May | 3,657 | 0 | 1,260 | 0 | 0 |
| | Mooneys Pond | 1+ parr | 21 Sep-1 Oct | 0 | 0 | 0 | 0 | 10,014 |
| | | | 28-29 Sep | 0 | 0 | 10,173 | 0 | 0 |
| | | 2+ smolt | 13-16 May | 0 | 0 | 0 | 0 | 10,307 |
| | | | 11-20 May | 0 | 0 | 10,221 | 0 | 0 |
| 1993 | Cardigan SEC | 0+ parr | 13 Oct | 0 | 0 | 0 | 0 | 14,467 |
| | | | 1 Dec | 0 | 0 | 0 | 20,000 | 0 |
| | | 1+ parr | 16-23 Jun | 0 | 0 | 0 | 0 | 28,898 |
| | Profitts Pond | 1+ parr | 28 May-22 Jun | 0 | 17,225 | 0 | 0 | 0 |
| | | 2+ parr | 3-4 May | 200 | 0 | 0 | 0 | 0 |
| | | 2+ smolt | 3-4 May | 2,772 | 5,325 | 0 | 0 | 0 |
| 1994 | Cardigan SEC | 0+ parr | Nov-97 | 0 | 0 | 0 | 20,000 | 20,000 |
| | | 1+ smolt | 9-10 May | 0 | 0 | 0 | 0 | 5,896 |
| | | | 12-15 May | 0 | 0 | 3,965 | 0 | 0 |
| | Profitts Pond | 2+ parr | 2-3 May | 127 | 341 | 209 | 0 | 0 |
| | | 2+ smolt | 2-3 May | 2,584 | 7,259 | 3,355 | 0 | 0 |
| | Mooneys Pond | 2+ smolt | 28 Apr-7 May | 0 | 0 | 0 | 0 | 1,980 |
| 1995 | Cardigan SEC | 1+ parr | | | | | 9,367[a] | 11,585[b] |
| | | 2+ smolt | 19 Apr-5 May | | | 5,037 | | 6,220 |
| | Profitts Pond | 2+ parr | 1-2 May | 364 | 280 | | | |
| | | 2+ smolt | 1-2 May | 3,923 | 5,179 | | | |
| | Mooneys Pond | 2+ parr | 13 May | | | 2,915 | | 3,937 |
| | | 2+ smolt | 13 May | | | 586 | | 1,330 |
| | Gilberts Pond | 2+ smolt | Spring | | | | | 4,030[c] |
| 1996 | Mooneys Pond | 2+ parr | 24 Apr | | | 212 | | 140 |
| | | 2+ smolt | 24 Apr | | | 2,005 | | 2,010 |
| | Munns Pond | 2+ smolt | 25-26 Apr | | | 4,754 | | 5,962 |
| | Profitts Pond | 2+ smolt | 29-30 Apr | 1,065 | 11,350 | | | |
| | Cardigan SEC | 1+ smolt | 22 Apr | | | | | 1,733 |
| | | 1+ parr | 1 Nov | | | | 8,564 | |
| | Gilberts Pond | 2+ smolt | Spring | | | | | 5,460[c] |

[a]Stocked 27 November

[b]Stocked 5 July

[c]Smolts leave in spring on their own accord, without being counted. Numbers are estimated from numbers of 1+ parr released in the pond in the previous year (6,200 in June 1994, 8,400 in June 1995), and assuming a survival rate of 65.%.

Table 6
Mailing and return statistics for the PEI salmon licence stub survey, 1995 and 1996.

| | 1995 | 1996 |
|---|---|---|
| Number of licences issued | 633 | 697 |
| Number of licence records available for keypunching | 633 | 646 |
| Number of licence records indicating province/state | | 645 |
| Number of licence records indicating purchase by PEI residents | | 585 |
| Number of licence records indicating purchase by Can. residents outside PEI | | 37 |
| Number of licence records indicating purchase by US residents | | 23 |
| Number of stubs returned before 13 Dec | 30 | 38 |
| Percent of stubs returned before 13 Dec | 4.7 | 5.5 |
| Number of stubs returned after 13 Dec | 29 | 25 |
| Total number of stubs returned | 59 | 63 |
| Percent of stubs returned | 9.3 | 9.0 |
| Number of licence records with legible addresses | 614 | 634 |
| Number of reminder cards mailed | 589 | 596 |
| Number of reminder cards returned as undeliverable | 35 | 28 |
| Number of reminder cards returned by anglers | 168 | 175 |
| Percent of reminder cards returned by anglers | 28.5 | 29.4 |
| Number of anglers who returned both stub and reminder cards | 6 | 1 |
| Total number of non-redundant cards returned | 221 | 237 |
| Number of non-redundant cards as a percent of licences issued | 34.9 | 34.0 |
| Number of non-redundant cards with full catch and effort data | 200 | 214 |
| Non-redundant cards with full catch and effort data as a percent of licences issued | 31.6 | 30.7 |
| Non-redundant cards with full data which reported fishing | 161 | 172 |
| Percent fishing | 80.5 | 80.4 |

Table 7
Salmon fishing effort and harvest in Prince Edward Island rivers, 1994-1996.

| | Morell | | | Mill | | | Trout | | | Dunk | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1994[a] | 1995[b] | 1996[b] | 1994 | 1995 | 1996 | 1994 | 1995 | 1996 | 1994 | 1995 | 1996 |
| Percent of respondents who fished river | | 72 | 66 | | 2 | 7 | | 3 | 7 | | 4 | 7 |
| Estimated total number of anglers who fished the river | | 453 | 462 | | 9 | 52 | | 19 | 46 | | 25 | 52 |
| Mean number of rod-days per angler who fished the river | | 11.2 | 9.0 | | 9.0 | 4.2 | | 13.5 | 6.1 | | 12.9 | 6.8 |
| Estimated total rod-days | | 5,073 | 4,156 | | 85 | 218 | | 256 | 277 | | 326 | 352 |
| Mean catch per rod-day | | | | | | | | | | | | |
| Small salmon kept | | 0.089 | 0.096 | | 0.000 | 0.119 | | 0.025 | 0.024 | | 0.000 | 0.009 |
| Small salmon released | | 0.029 | 0.065 | | 0.000 | 0.075 | | 0.012 | 0.000 | | 0.010 | 0.306 |
| Large salmon released | | 0.019 | 0.036 | | 0.000 | 0.030 | | 0.012 | 0.024 | | 0.000 | 0.037 |
| All salmon | | 0.136 | 0.197 | | 0.000 | 0.224 | | 0.049 | 0.047 | | 0.010 | 0.352 |
| Estimated total catch | | | | | | | | | | | | |
| Small salmon kept | 89 | 449 | 397 | 11 | 0 | 26 | 5 | 6 | 7 | 11 | 0 | 3 |
| Small salmon released | 111 | 146 | 270 | NA[c] | 0 | 16 | 6 | 3 | 0 | 38 | 3 | 107 |
| Large salmon released | 99 | 95 | 150 | 0 | 0 | 7 | 0 | 3 | 7 | 5 | 0 | 13 |
| All catches | 299 | 690 | 818 | NA | 0 | 49 | 11 | 13 | 13 | 54 | 3 | 124 |
| Native harvest | | | | | | | | | | | | |
| Small salmon | | 19 | 17 | | | | | | | | | |
| Large salmon | | 1 | 0 | | | | | | | | | |
| Total lethal harvest | 299 | 469 | 414 | NA | 0 | 26 | 11 | 6 | 7 | 54 | 0 | 3 |

| | West | | | Valleyfield[d] | | | Montague[d] | | | All rivers | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1994 | 1995 | 1996 | 1994 | 1995 | 1996 | 1994 | 1995 | 1996 | 1994 | 1995 | 1996 |
| Percent of respondents who fished river | | 16 | 24 | | 4 | 12 | | 1 | 0 | | 80 | 81 |
| Estimated total number of anglers who fished the river | | 101 | 166 | | 22 | 85 | | 6 | 0 | | 506 | 563 |
| Mean number of rod-days per angler who fished the river | | 12.7 | 6.1 | | 28.1 | 5.5 | | 1.5 | NA | | 15.1 | 11.5 |
| Estimated total rod-days | | 1,282 | 1,006 | | 624 | 466 | | 9 | 0 | | 7,669 | 6,478 |
| Mean catch per rod-day | | | | | | | | | | | | |
| Small salmon kept | | 0.010 | 0.061 | | 0.025 | 0.077 | | 0.000 | NA | | 0.063 | 0.082 |
| Small salmon released | | 0.030 | 0.055 | | 0.015 | 0.049 | | 0.333 | NA | | 0.027 | 0.073 |
| Large salmon released | | 0.017 | 0.042 | | 0.025 | 0.042 | | 0.000 | NA | | 0.018 | 0.037 |
| All salmon | | 0.057 | 0.159 | | 0.066 | 0.168 | | 0.333 | NA | | 0.109 | 0.192 |
| Estimated total catch | | | | | | | | | | | | |
| Small salmon kept | 20 | 13 | 62 | 5 | 16 | 36 | | 0 | 0 | 142 | 484 | 534 |
| Small salmon released | 38 | 38 | 55 | 28 | 9 | 23 | | 3 | 0 | NA | 209 | 472 |
| Large salmon released | NA | 22 | 42 | 5 | 16 | 20 | | 0 | 0 | NA | 139 | 238 |
| All catches | NA | 73 | 160 | 38 | 41 | 78 | | 3 | 0 | NA | 832 | 1244 |
| Native harvest | | | | | | | | | | | | |
| Small salmon | | | | | | | | | | | 19 | 17 |
| Large salmon | | | | | | | | | | | 1 | 0 |
| Total lethal harvest | NA | 13 | 62 | 38 | 16 | 36 | | 0 | 0 | NA | 504 | 551 |

[a]1994 data are from a mail-out survey (Cairns 1996).
[b]1995-1996 data are from licence stub surveys.
[c]Harvest estimates that are implausibly high (Cairns et al. 1996) are omitted from this table.
[d]1994 Montague data are included with those of the Valleyfield.

Table 8

Atlantic salmon counted at Leards fishway and released into Leards Pond after broodstock removals, 1981-1996.

| Year | Small salmon | | | | | | Large salmon | | | | | | All salmon | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Counted in trap | | | | | Re- | Counted in trap | | | | | Re- | Counted in trap | | | | Re- |
| | Wild | Hatch-ery | Total | % wild | % small | leased in pond | Wild | Hatch-ery | Total | % wild | % large | leased in pond | Wild | Hatch-ery | Total | % wild | leased in pond |
| Actual counts | | | | | | | | | | | | | | | | | |
| 1981 | 0 | 39 | 39 | 0.0 | 86.7 | 39 | 6 | 0 | 6 | 100.0 | 13.3 | 6 | 6 | 39 | 45 | 13.3 | 45 |
| 1982 | 6 | 27 | 33 | 18.2 | 91.7 | 33 | 1 | 2 | 3 | 33.3 | 8.3 | 3 | 7 | 29 | 36 | 19.4 | 36 |
| 1983 | 1 | 1 | 2 | 50.0 | 50.0 | 2 | 0 | 2 | 2 | 0.0 | 50.0 | 2 | 1 | 3 | 4 | 25.0 | 4 |
| 1984 | 3 | 2 | 5 | 60.0 | 55.6 | 5 | 2 | 2 | 4 | 50.0 | 44.4 | 4 | 5 | 4 | 9 | 55.6 | 9 |
| 1985 | 2 | 12 | 14 | 14.3 | 93.3 | 14 | 1 | 0 | 1 | 100.0 | 6.7 | 1 | 3 | 12 | 15 | 20.0 | 15 |
| 1986 | 1 | 619 | 620 | 0.2 | 99.0 | 278 | 2 | 4 | 6 | 33.3 | 1.0 | 3 | 3 | 623 | 626 | 0.5 | 281 |
| 1987 | 2 | 1,166 | 1,168 | 0.2 | 94.5 | 658 | 2 | 66 | 68 | 2.9 | 5.5 | 54 | 4 | 1,232 | 1,236 | 0.3 | 712 |
| 1988 | 8 | 1,386 | 1,394 | 0.6 | 94.1 | 1,290 | 2 | 87 | 89 | 2.2 | 6.0 | 20 | 10 | 1,471 | 1,481 | 0.7 | 1,310 |
| 1989 | 12 | 323 | 335 | 3.6 | 72.8 | 330 | 0 | 125 | 125 | 0.0 | 27.2 | 48 | 12 | 448 | 460 | 2.6 | 378 |
| 1990 | 44 | 365 | 409 | 10.8 | 86.7 | 368 | 4 | 59 | 63 | 6.3 | 13.3 | 44 | 48 | 424 | 472 | 10.2 | 412 |
| 1991 | 33 | 294 | 327 | 10.1 | 89.3 | 280 | 11 | 28 | 39 | 28.2 | 10.7 | 14 | 44 | 322 | 366 | 12.0 | 294 |
| 1992 | 64 | 843 | 907 | 7.1 | 95.2 | 824 | 8 | 38 | 46 | 17.4 | 4.8 | 14 | 72 | 881 | 953 | 7.6 | 838 |
| 1993 | 44 | 584 | 628 | 7.0 | 98.3 | 461 | 0 | 11 | 11 | 0.0 | 1.7 | 0 | 44 | 595 | 639 | 6.9 | 461 |
| 1994 | 8 | 28 | 36 | 22.2 | 55.4 | 2 | 2 | 27 | 29 | 6.9 | 44.6 | 3 | 10 | 55 | 65 | 15.4 | 5 |
| 1995 | 14 | 172 | 186 | 7.5 | 92.5 | 130 | 5 | 10 | 15 | 33.3 | 7.5 | 2 | 19 | 182 | 201 | 9.5 | 132 |
| 1996 | 31 | 188 | 219 | 14.2 | 88.0 | 169 | 4 | 26 | 30 | 13.3 | 12.0 | 20 | 35 | 214 | 249 | 14.1 | 189 |
| Adjusted counts[a] | | | | | | | | | | | | | | | | | |
| 1994 | 20 | 70 | 90 | | | 56 | 5 | 68 | 73 | | | 47 | 25 | 138 | 163 | | 103 |
| 1995 | 35 | 430 | 465 | | | 409 | 13 | 25 | 38 | | | 25 | 48 | 455 | 503 | | 434 |
| 1996 | 78 | 470 | 548 | | | 498 | 10 | 65 | 75 | | | 65 | 88 | 535 | 623 | | 563 |
| Totals and means[b] | | | | | | | | | | | | | | | | | |
| Total | 273 | 6,049 | 6,322 | | | 4,883 | 50 | 487 | 537 | | | 238 | 323 | 6,534 | 6,857 | | 5,121 |
| Mean | 17.1 | 378.1 | 395.1 | 4.3 | 92.2 | 305.2 | 3.1 | 30.4 | 33.6 | 9.3 | 7.8 | 14.9 | 20.2 | 408.4 | 428.6 | 4.7 | 320.1 |

[a]Estimated number of fish entering Leards Pond, based on the fishway trapping efficiency calculated for 1996 (40.0%)

[b]Based on actual counts

Table 9
Biological characteristics of fish recaptured at the pool below Mooneys Pond, and mark-recapture estimates of salmon numbers on the Morell River, 1996

| | Number | Percent |
|---|---|---|
| Counts at Leards, 31 May-31 July | | |
| Small salmon counted | 189 | |
| Large salmon counted | 18 | |
| Small salmon removed for broodstock | 50 | |
| Large salmon removed for broodstock | 10 | |
| Dye-marked fish put into pond | | |
| Small | 139 | |
| Large | 8 | |
| Total | 147 | |
| Captures at pool below Mooneys Pond | | |
| Number of salmon | | |
| Taken by natives in August | 17 | |
| With dye-marks, harvested by natives | 4 | 23.5% |
| Captured on 2 October, and V-notched | 8 | |
| Captured on 5 October | 99 | |
| Captured on 5 October with V-notches | 4 | 4.0% |
| Captured on 2-5 October - total[a] | 103 | |
| Captured on 2-5 October - small | 99 | |
| Captured on 2-5 October - large | 4 | |
| Captured on 2-5 October with dye marks - total | 34 | 33.0% |
| Captured on 2-5 October with dye marks - small | 32 | |
| Captured on 2-5 October with dye marks - large | 2 | |
| Percent of marked fish which were recaptured at Mooneys 2-5 Oct | | |
| Small | | 23.0% |
| Large | | 25.0% |
| Overall | | 23.1% |
| Timing and age of October captures at Mooneys | | |
| Fish marked at Leards 31 May-30 June | 53 | |
| Recaptured at Mooneys | 15 | 28.3% |
| Fish marked at Leards July | 94 | |
| Recaptured at Mooneys | 19 | 20.2% |
| Fish marked at Leards August-November | 42 | |
| Recaptured at Mooneys | 0 | 0.0% |
| Small salmon aged[b] | 6 | |
| Age 2.1+ | 3 | 50.0% |
| Age 3.1+ | 2 | 33.3% |
| Age 4.1+ | 1 | 16.7% |
| Mark-recapture estimates | | |
| Number of salmon in pool below Mooneys | | |
| Baysian median | 285 | |
| 95% confidence limits | 105-933 | |
| Fish entering Leards Pond, 31 May-31 July | | |
| Estimated from native recaptures | | |
| Baysian median | 868 | |
| 95% confidence limits | 368-2558 | |
| Estimated from recaptures on 2 & 5 Oct | | |
| Baysian median | 458 | |
| 95% confidence limits | 354-622 | |
| Fish arriving at Leards, 31 May-31 July (from October recaptures) | | |
| (Estimate of fish entering Leards Pond + broodstock removals) | 518 | |
| Capture efficiency (total counted/total estimated arrivals) | 0.400 | |
| Number of salmon counted at Leards after 31 July | 42 | |
| Broodstock removals after 31 July | 0 | |
| Fish arriving at Leards after 31 July (based on capture efficiency) | 105 | |
| Estimated total arriving at Leards | 623 | |
| Estimated total entering Leards Pond | 563 | |

[a]Fish captured on both days are counted here only once
[b]The first digit is river age, the second digit is sea age

Table 10
Counts of Atlantic salmon and brook trout at counting facilities on the Mill, Dunk, West, and Valleyfield Rivers, 1986-1996.

| Year | Direction | Mill River | | | | | Dunk River[a] | | | | | West River | | | | | Valleyfield River | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Trout | Salmon | | | | Trout | Salmon | | | | Trout | Salmon | | | | Trout | Salmon | | | |
| | | | Adult | | | Juvenile | | Adult | | | Juvenile | | Adult | | | Juvenile | | Adult | | | Juvenile |
| | | | Small | Large | Total | | | Small | Large | Total | | | Small | Large | Total | | | Small | Large | Total | |
| 1986 | Upstream | | | | | | | | | | | | | | | | 723 | | | 0 | |
| 1987 | Upstream | | | | | | 937 | | | | | | | | | | - | | | - | |
| 1988 | Upstream | | | | | | 1,507 | | | | | | | | | | - | | | - | |
| 1989 | Upstream | | | | | | 4,189 | | | | | - | 31 | 19 | 50 | | 1,220 | | | 0 | |
| 1990 | Upstream | 2,594 | | | 176 | | - | | | | | 3,935 | 25 | 23 | 48 | | 2,173 | 36 | | 36 | |
| | Downstream | - | | | - | | - | | | | | 2,986 | | | - | | - | | | - | |
| 1991 | Upstream | 4,221 | | | - | | 1,733 | | | | | - | | | - | | 1,565 | 5 | | 5 | |
| | Upstream | - | | | - | | 1,132 | | | | | - | | | - | | 741 | 25 | | 25 | |
| 1993 | Upstream | 219 | 17 | 5 | 22 | | 1,295 | | | 0 | | 2,151 | 250 (248)[b] | 12 (12) | 262 (260) | | 1,027 | 84 | | 84 | |
| | Downstream | - | | | - | | - | | | - | | 1,006 | | | 10 | 66 | - | | | - | |
| 1994[c] | Upstream | 1,947 | 11 (11) | 0 | 11 (11) | | N/A | | | N/A | | 2,072 | 8 (4) | 6 (6) | 14[d] (10) | | 1,609 | 15 | 7 | 22 | |
| | Downstream | | | | | | | | | | | | 1 | 1 | 2 | | - | | | - | |
| 1995 | Upstream | 320 | 3 | 27 | 30 | | 121 | 40 | 0 | 40 | | | | | | | 1,401 | 58 | 4 | 62 | 95 |
| | Downstream | | | | | | 32 | 2 | 0 | 2 | 11 | | | | | | 39 | 3 | 0 | 3 | 19 |
| 1996 | Upstream | | | | | | | | | | | | | | | | 977 | 75 | 8 | 83 | 23 |
| | Downstream | | | | | | | | | | | | | | | | 51 | 2 | 0 | 2 | 10 |

[a]Counts from fish fence above Johnston's Bridge in 1995; counts from Scales Pond fishway in all other years.
[b]Brackets indicate hatchery-reared salmon
[c]Counting facilities operated from 30 May to 17 September (West River), from 27 May to 27 October (Mill River), and from 29 May to 3 November (Valleyfield River).
[d]Every second conduit was removed from the counting fence, allowing some small salmon to pass through the fence.

Table 11
Counts of Atlantic salmon redds in Prince Edward Island rivers, 1990-1996.

| River | Sector | Number of salmon redds | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996[a] |
| Morell | Main Branch below Forks + West Branch from Forks to Leards Dam | 89 | 204 | 145 | 125 | 65 | 104 | 75 |
| | West Branch above Leards Pond | 158 | 177 | 344 | 138 | 17 | 46[b] | 145 |
| | South Branch | 207 | 118 | 306 | 77 | 45[b] | 144 | 163 |
| | East Branch | 202 | 138 | 122 | 37 | 35 | 15 | 55 |
| | Total above Leards Pond | 365 | 295 | 650 | 215 | N/A | 190 | 308 |
| | Total | 656 | 637 | 917 | 377 | N/A | 309 | 438 |
| Mill | Bridge on Rte 143 (Maggies Hole) to Roadside Hole, where the river comes close to road 2.01 km upstream from the Howlan railway bridge (Transects 10 - 102) | N/A | N/A | N/A | 100 | N/A | N/A | N/A |
| | Roadside Hole to Howlan railway bridge (Transects 102 - 169) | N/A | N/A | N/A | 55 | N/A | N/A | N/A |
| | Howlan railway bridge to the head of tide in Bloomfield Park (Transects 169-336) | N/A | N/A | N/A | 156 | 144 | N/A | N/A |
| | Total | N/A | N/A | N/A | 311 | N/A | N/A | N/A |
| Trout | From railroad bridge just below Leards Pond to base of the former Getsons Dam (Transects 1-180) | N/A | N/A | 33 | 58 | 33 | N/A | 42 |
| Dunk | Head of tide to Scales Pond | N/A | N/A | N/A | 6 | N/A | N/A | N/A |
| West | Sector 1 - Head of tide to first bridge above Crosbys Pond | 6 | N/A | 15 | 6 | 17 | 13 | N/A |
| | Sector 2 - First bridge above Crosbys Pond to bridge on Rte. 249 at Green Bay | 41 | 19 | 168 | 77 | 25 | 44 | N/A |
| | Sector 3 - Bridge on Rte 249 at Green Bay to bridge on Rte 249 at Emyvale | N/A | 4 | 91 | 59 | N/A | N/A | N/A |
| | Sector 4 - Bridge on Rte. 249 at Emyvale to the point where the main branch crosses Rte. 13 at Brookvale; also the tributary to the bridge on Rte. 235 | N/A | 5 | N/A | 22 | 17 | N/A | N/A |
| | Sector 5 - From bridge on Rte. 235 at Brookvale, following the east branch to the bridge on Rte. 225 at Hartsville | N/A | 0 | N/A | N/A | N/A | N/A | N/A |
| | Sector 6 - From Bridge at Rte. 235 to Carraghers Pond, just above Rte. 244. | N/A | 2 | N/A | 0 | N/A | N/A | N/A |
| | Sector 7 - From the head of Carraghers Pond to the bridge at Rte. 245 | N/A | 0 | N/A | N/A | N/A | N/A | N/A |
| | Sector 8 - Howells Brook from the bridge on Rte. 245 to the bridge on Rte. 244 | N/A | 3 | N/A | 0 | 0 | N/A | N/A |
| Bristol Creek | | N/A | N/A | N/A | 41 | N/A | N/A | 49 |
| Midgell | From Pius MacDonalds Pond to head of tide | N/A | N/A | N/A | 77 | N/A | N/A | 73 |
| St. Peters | | N/A | N/A | N/A | 93 | N/A | N/A | 30 |
| Naufrage | From Larkins Pond to head of tide | N/A | N/A | N/A | 32 | N/A | N/A | 88 |
| North Lake Creek | | N/A | 29 | 200 | 36 | N/A | N/A | N/A |

[a]Data supplied by D.L. Guignion, D. Biggar, C. Crane, T. Dupuis, and R. MacFarlane
[b]Minimum count; some fish ascended the river after the redd survey was completed

Table 12

Atlantic salmon and brook trout electrofishing densities on the Morell River, August-September 1996.

| Site | Date | Area of site ($m^2$) | Atlantic salmon | | | | | | | | | | | | | Brook trout | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fish captured in sweep | | | | | | | Zippin estimates | | | | | | Fish captured in sweep | | | | Zippin estimates | | |
| | | | 1 | 2 | 3 | Total | % age distribution[a] | | | Total pop. in site[b] | 95% CI, ± | Fish/100 $m^2$ within site | | | | 1 | 2 | 3 | Total | Total pop. in site[c] | 95% CI, ± | Total fish/ 100 $m^2$ |
| | | | | | | | 0+ | 1+ | 2+ | | | 0+ | 1+ | 2+ | Total | | | | | | | |
| Rowell's Riffle | 4 Sep | 337 | 13 | 8 | 3 | 24 | 29.2 | 62.5 | 8.3 | 27.7 | NA | 2.6 | 5.6 | 0.7 | 8.2 | 8 | 5 | 2 | 15 | 17.6 | NA | 5.2 |
| Forks | 21 Aug | 406 | 44 | 25 | 9 | 78 | 23.1 | 61.5 | 15.4 | 87.8 | 13.7% | 5.9 | 15.7 | 3.3 | 21.6 | 18 | 6 | 4 | 28 | 30.5 | NA | 7.5 |
| Grants | 21 Aug | 472 | 16 | NA | NA | 16 | 37.5 | 37.5 | 25.0 | 34.5 | NA | 3.7 | 3.7 | 1.8 | 7.3 | 19 | NA | NA | 19 | 38.0 | NA | 8.1 |
| Above Landing Pool | 30 Aug | 432 | 9 | NA | NA | 9 | 66.7 | 22.2 | 11.1 | 19.4 | NA | 3.4 | 1.1 | 0.5 | 4.5 | 8 | NA | NA | 8 | 16.0 | NA | 3.7 |
| Leard's Bridge | 19 Aug | 255 | 36 | 20 | 11 | 67 | 82.1 | 4.5 | 13.4 | 80.7 | 20.2% | 30.0 | 1.6 | 4.2 | 31.6 | 0 | 0 | 0 | 0 | 0.0 | NA | 0.0 |
| Kenny's Hole | 14 Aug | 92 | 16 | 5 | 0 | 21 | 33.3 | 0.0 | 66.7 | 21.2 | NA | 23.0 | 0.0 | 15.3 | 23.0 | 32 | 19 | 8 | 59 | 68.7 | 15.7% | 74.5 |
| Upper Kenny's | 19 Aug | 185 | 14 | NA | NA | 14 | 57.1 | 7.1 | 35.7 | 30.2 | NA | 14.5 | 1.8 | 5.8 | 16.3 | 22 | NA | NA | 22 | 44.0 | NA | 23.8 |
| Mooney Tracks | 22 Aug | 140 | 17 | NA | NA | 17 | 64.7 | 5.9 | 29.4 | 36.6 | NA | 24.0 | 2.2 | 7.7 | 26.2 | 22 | NA | NA | 22 | 44.0 | NA | 31.5 |
| Gill Road | 28 Aug | 84 | 4 | NA | NA | 4 | 0.0 | 100.0 | 0.0 | 8.6 | NA | 0.0 | 10.3 | 0.0 | 10.3 | 20 | NA | NA | 20 | 40.0 | NA | 47.7 |
| Old Cardigan III | 15 Aug | 165 | 4 | NA | NA | 4 | 50.0 | 25.0 | 25.0 | 8.6 | NA | 3.5 | 1.7 | 1.3 | 5.2 | 8 | NA | NA | 8 | 16.0 | NA | 9.7 |
| Lower Crane's | 29 Aug | 212 | 15 | NA | NA | 15 | 40.0 | 26.7 | 33.3 | 32.3 | NA | 9.1 | 6.1 | 5.1 | 15.2 | 23 | NA | NA | 23 | 46.0 | NA | 21.7 |
| Crane's | 20 Aug | 365 | 34 | 16 | 7 | 57 | 52.6 | 14.0 | 33.3 | 63.1 | 10.7% | 13.6 | 3.6 | 5.8 | 17.3 | 24 | 10 | 4 | 38 | 40.8 | NA | 11.2 |
| Everglades | 28 Aug | 212 | 0 | NA | NA | 0 | NA | NA | NA | 0.0 | NA | 0.0 | 0.0 | 0.0 | 0.0 | 3 | NA | NA | 3 | 6.0 | NA | 2.8 |
| Martinvale | 26 Aug | 150 | 0 | NA | NA | 0 | NA | NA | NA | 0.0 | NA | 0.0 | 0.0 | 0.0 | 0.0 | 5 | NA | NA | 5 | 10.0 | NA | 6.7 |

[a]Ages determined from length distribution (Fig. 11). Fish below 8.25 cm are 0+, fish above 11.45 cm are 2+

[b]Where only single sweeps were performed, populations were estimated from Sweep 1 captures as a percent of Zippin estimates, in sites where multiple sweeps were performed. Mean=46.4%, N=20.

[c]Populations estimated from single sweeps as for salmon; mean=50.0%, N=16.

Table 13
Densities and populations of juvenile Atlantic salmon on the Morell River, 1975-1996.

| Site[a] | | 8-12 Sep 1975 | 11 Aug-11 Sep 1984 (wild) | 11 Aug-11 Sep 1984 (hatchery) | 21 Aug-5 Sep 1985 | 23 Aug-7 Sep 1994 | 15-27 Dec 1994 | 24 Jul-22 Aug 1995 | 24 Oct-7 Nov 1995 | 14 Aug-4 Sep 1996 |
|---|---|---|---|---|---|---|---|---|---|---|
| | Source | Ducharme 1977 | Cairns et al. 1995 | Cairns et al. 1995 | Cairns et al. 1995 | Cairns et al. 1995 | Cairns et al. 1995 | Cairns et al. 1996 | Cairns et al. 1996 | This study |
| **Main Stem (mouth to Forks)** | | | | | | | | | | |
| Indian Bridge | 0+ fish /100 $m^2$ | 0.0 | | | | | | | | |
| | 1+ fish /100 $m^2$ | 0.6 | | | | | | | | |
| | 2+ fish /100 $m^2$ | 0.0 | | | | | | | | |
| | Total fish /100 $m^2$ | 0.6 | | | | | | | | |
| Rowells Riffle | 0+ fish /100 $m^2$ | | | | 9.4 | 1.0 | 0.0 | 8.1 | 5.9 | 2.6 |
| | 1+ fish /100 $m^2$ | | | | 3.5 | 5.5 | 3.3 | 1.2 | 2.6 | 5.6 |
| | 2+ fish /100 $m^2$ | | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 |
| | Total fish /100 $m^2$ | | | | 12.9 | 6.5 | 3.3 | 9.3 | 8.5 | 8.2 |
| Mooneys Bridge | 0+ fish /100 $m^2$ | 0.0 | | | 7.2 | 1.7 | 0.0 | | | |
| | 1+ fish /100 $m^2$ | 1.5 | | | 4.1 | 2.3 | 1.3 | | | |
| | 2+ fish /100 $m^2$ | 0.0 | | | 0.0 | 0.0 | 0.0 | | | |
| | Total fish /100 $m^2$ | 1.5 | | | 11.3 | 4.0 | 1.3 | | | |
| Grants | 0+ fish /100 $m^2$ | 0.0 | | | | | | 2.3 | 4.3 | 3.7 |
| | 1+ fish /100 $m^2$ | 3.8 | | | | | | 2.9 | 3.8 | 3.7 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 1.8 |
| | Total fish /100 $m^2$ | 3.8 | | | | | | 5.2 | 8.1 | 7.3 |
| Forks | 0+ fish /100 $m^2$ | 0.0 | 9.8 | 0.0 | | 25.9 | 3.8 | 13.6 | 23.2 | 5.9 |
| | 1+ fish /100 $m^2$ | 5.9 | 7.2 | 0.3 | | 12.4 | 0.5 | 3.7 | 8.4 | 15.7 |
| | 2+ fish /100 $m^2$ | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 3.3 |
| | Total fish /100 $m^2$ | 5.9 | 17.0 | 0.3 | | 38.4 | 4.3 | 17.3 | 31.7 | 21.6 |
| Main Stem means and totals: | | | | | | | | | | |
| 0+ fish/100 $m^2$ | Mean | 0.0 | 9.8 | 0.0 | 8.3 | 9.5 | 1.3 | 8.0 | 11.2 | 4.1 |
| | SD | 0.0 | NA | NA | 1.5 | 14.2 | 2.2 | 5.7 | 10.5 | 1.7 |
| 1+ fish/100 $m^2$ | Mean | 3.0 | 7.2 | 0.3 | 3.8 | 6.7 | 1.7 | 2.6 | 4.9 | 8.3 |
| | SD | 2.4 | NA | NA | 0.4 | 5.2 | 1.4 | 1.2 | 3.1 | 6.5 |
| 2+ fish/100 $m^2$ | Mean | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 |
| | SD | 0.0 | NA | NA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 |
| Total fish/100 $m^2$ | Mean | 3.0 | 17.0 | 0.3 | 12.1 | 16.3 | 3.0 | 10.6 | 16.1 | 12.4 |
| | SD | 2.4 | NA | NA | 1.1 | 19.2 | 1.6 | 6.2 | 13.5 | 8.0 |
| | N | 4 | 1 | 1 | 2 | 3 | 3 | 3 | 3 | 3 |
| Area ($m^2$) | 92,494 | | | | | | | | | |
| Population | 0+ fish | 0 | 9,098 | 0 | 7,660 | 8,826 | 1,172 | 7,388 | 10,321 | 3,752 |
| | 1+ fish | 2,729 | 6,615 | 276 | 3,531 | 6,240 | 1,592 | 2,394 | 4,568 | 7,703 |
| | 2+ fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,800 |
| | Total fish | 2,729 | 15,713 | 276 | 11,191 | 15,066 | 2,764 | 9,783 | 14,889 | 11,455 |
| **West and South Branches** | | | | | | | | | | |
| Above Landing Pool | 0+ fish /100 $m^2$ | | | | | | | 9.8 | 11.4 | 3.4 |
| | 1+ fish /100 $m^2$ | | | | | | | 1.0 | 2.8 | 1.1 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 0.5 |
| | Total fish /100 $m^2$ | | | | | | | 10.8 | 14.2 | 4.5 |
| Lower Leards | 0+ fish /100 $m^2$ | | | | 10.4 | | | | | |
| | 1+ fish /100 $m^2$ | | | | 4.0 | | | | | |
| | 2+ fish /100 $m^2$ | | | | 0.0 | | | | | |
| | Total fish /100 $m^2$ | | | | 14.3 | | | | | |
| Leards Bridge | 0+ fish /100 $m^2$ | 0.0 | 17.0 | 0.0 | 11.0 | 19.4 | 10.1 | 27.1 | 16.6 | 30.0 |
| | 1+ fish /100 $m^2$ | 5.1 | 1.7 | 1.3 | 9.7 | 4.4 | 3.0 | 4.5 | 15.0 | 1.6 |
| | 2+ fish /100 $m^2$ | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.2 |
| | Total fish /100 $m^2$ | 5.1 | 18.7 | 1.3 | 20.7 | 23.9 | 13.1 | 31.6 | 31.6 | 31.6 |

Table 13 (continued)

| Site[a] | | 8-12 Sep 1975 | 11 Aug-11 Sep 1984 (wild) | 11 Aug-11 Sep 1984 (hatchery) | 21 Aug-5 Sep 1985 | 23 Aug-7 Sep 1994 | 15-27 Dec 1994 | 24 Jul-22 Aug 1995 | 24 Oct-7 Nov 1995 | 14 Aug-4 Sep 1996 |
|---|---|---|---|---|---|---|---|---|---|---|
| Kennys Hole | 0+ fish /100 $m^2$ | | 0.0 | 0.0 | 0.0 | 112.1 | 22.0 | 0.0 | 6.3 | 23.0 |
| | 1+ fish /100 $m^2$ | | 0.6 | 1.9 | 2.7 | 30.9 | 0.0 | 16.8 | 10.5 | 0.0 |
| | 2+ fish /100 $m^2$ | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 15.3 |
| | Total fish /100 $m^2$ | | 0.6 | 1.9 | 2.7 | 142.9 | 22.0 | 16.8 | 16.7 | 23.0 |
| Upper Kennys | 0+ fish /100 $m^2$ | | | | | | | 0.0 | 2.2 | 14.5 |
| | 1+ fish /100 $m^2$ | | | | | | | 9.7 | 1.1 | 1.8 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 5.8 |
| | Total fish /100 $m^2$ | | | | | | | 9.7 | 3.2 | 16.3 |
| Mooney Tracks | 0+ fish /100 $m^2$ | | | | | | | 14.5 | 21.0 | 24.0 |
| | 1+ fish /100 $m^2$ | | | | | | | 30.5 | 14.0 | 2.2 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 7.7 |
| | Total fish /100 $m^2$ | | | | | | | 45.0 | 35.1 | 26.2 |
| Gill Road | 0+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 0.0 |
| | 1+ fish /100 $m^2$ | | | | | | | 2.5 | 0.0 | 10.3 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 0.0 |
| | Total fish /100 $m^2$ | | | | | | | 2.5 | 0.0 | 10.3 |
| Oates | 0+ fish /100 $m^2$ | | | | | | | 1.6 | 2.3 | |
| | 1+ fish /100 $m^2$ | | | | | | | 4.7 | 1.6 | |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | |
| | Total fish /100 $m^2$ | | | | | | | 6.2 | 3.9 | |
| Old Cardigan III | 0+ fish /100 $m^2$ | | | | | | | 13.6 | 12.6 | 3.5 |
| | 1+ fish /100 $m^2$ | | | | | | | 32.6 | 25.2 | 1.7 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 1.3 |
| | Total fish /100 $m^2$ | | | | | | | 46.1 | 37.8 | 5.2 |
| West and South Branches means and totals:[b] | | | | | | | | | | |
| 0+ fish/100 $m^2$ | Mean | 0.0 | 8.5 | 0.0 | 7.1 | 65.8 | 16.0 | 9.5 | 10.3 | 16.4 |
| | SD | NA | 12.0 | 0.0 | 6.2 | 65.5 | 8.4 | 10.0 | 7.2 | 11.2 |
| 1+ fish/100 $m^2$ | Mean | 5.1 | 1.1 | 1.6 | 5.5 | 17.7 | 1.5 | 14.2 | 10.0 | 1.4 |
| | SD | NA | 0.7 | 0.4 | 3.7 | 18.7 | 2.1 | 12.8 | 8.9 | 0.8 |
| 2+ fish/100 $m^2$ | Mean | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 |
| | SD | NA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.4 |
| Total fish/100 $m^2$ | Mean | 5.1 | 9.7 | 1.6 | 12.6 | 83.4 | 17.6 | 23.7 | 20.4 | 17.8 |
| | SD | NA | 12.8 | 0.4 | 9.1 | 84.2 | 6.3 | 17.0 | 14.5 | 11.2 |
| | N | 1 | 2 | 2 | 3 | 2 | 2 | 7 | 7 | 6 |
| Area ($m^2$) | 103,996 | | | | | | | | | |
| Population | 0+ fish | 0 | 8,860 | 0 | 7,407 | 68,378 | 16,681 | 9,879 | 10,751 | 17,037 |
| | 1+ fish | 5,304 | 1,194 | 1,681 | 5,685 | 18,356 | 1,575 | 14,811 | 10,422 | 1,472 |
| | 2+ fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,048 |
| | Total fish | 5,304 | 10,054 | 1,681 | 13,092 | 86,733 | 18,256 | 24,690 | 21,173 | 18,509 |
| West and South Branches means and totals (above Leards only):[b] | | | | | | | | | | |
| 0+ fish/100 $m^2$ | Mean | | 0.0 | 0.0 | 0.0 | 112.1 | 22.0 | 4.9 | 7.4 | 13.0 |
| | SD | | N/A | N/A | N/A | N/A | N/A | 7.1 | 8.0 | 11.0 |
| 1+ fish/100 $m^2$ | Mean | | 0.6 | 1.9 | 2.7 | 30.9 | 0.0 | 16.1 | 8.7 | 3.2 |
| | SD | | N/A | N/A | N/A | N/A | N/A | 12.9 | 9.9 | 4.0 |
| 2+ fish/100 $m^2$ | Mean | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.0 |
| | SD | | N/A | N/A | N/A | N/A | N/A | 0.0 | 0.0 | 6.1 |
| Total fish/100 $m^2$ | Mean | | 0.6 | 1.9 | 2.7 | 142.9 | 22.0 | 21.1 | 16.1 | 16.2 |
| | SD | | N/A | N/A | N/A | N/A | N/A | 21.1 | 16.1 | 16.2 |
| | N | | 1 | 1 | 1 | 1 | 5 | 6 | 6 | 5 |
| Area ($m^2$) | 74,727 | | | | | | | | | |
| Population | 0+ fish | | 0 | 0 | 0 | 83,739 | 16,428 | 3,692 | 5,531 | 9,707 |
| | 1+ fish | | 473 | 1,418 | 2,037 | 23,058 | 0 | 12,041 | 6,516 | 2,391 |
| | 2+ fish | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,506 |
| | Total fish | | 473 | 1,418 | 2,037 | 106,797 | 16,428 | 15,733 | 12,047 | 12,099 |

Table 13 (continued)

| Site[a] | | 8-12 Sep 1975 | 11 Aug-11 Sep 1984 (wild) | 11 Aug-11 Sep 1984 (hatchery) | 21 Aug-5 Sep 1985 | 23 Aug-7 Sep 1994 | 15-27 Dec 1994 | 24 Jul-22 Aug 1995 | 24 Oct-7 Nov 1995 | 14 Aug-4 Sep 1996 |
|---|---|---|---|---|---|---|---|---|---|---|
| **East Branch** | | | | | | | | | | |
| Lower Cranes | 0+ fish /100 $m^2$ | | | | | | | 2.0 | 9.4 | 9.1 |
| | 1+ fish /100 $m^2$ | | | | | | | 6.0 | 2.8 | 6.1 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 5.1 |
| | Total fish /100 $m^2$ | | | | | | | 8.0 | 12.2 | 15.2 |
| Cranes | 0+ fish /100 $m^2$ | | 6.7 | 0.0 | 2.5 | 36.1 | 6.5 | 6.4 | 12.0 | 13.6 |
| | 1+ fish /100 $m^2$ | | 1.3 | 0.0 | 2.0 | 2.0 | 0.0 | 4.7 | 8.9 | 3.6 |
| | 2+ fish /100 $m^2$ | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 |
| | Total fish /100 $m^2$ | | 8.0 | 0.0 | 4.6 | 38.1 | 6.5 | 11.1 | 21.0 | 17.3 |
| Everglades | 0+ fish /100 $m^2$ | | | | | | | 0.0 | 1.0 | 0.0 |
| | 1+ fish /100 $m^2$ | | | | | | | 6.0 | 3.1 | 0.0 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 0.0 |
| | Total fish /100 $m^2$ | | | | | | | 6.0 | 4.1 | 0.0 |
| Martinvale | 0+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 0.0 |
| | 1+ fish /100 $m^2$ | | | | | | | 1.2 | 3.3 | 0.0 |
| | 2+ fish /100 $m^2$ | | | | | | | 0.0 | 0.0 | 0.0 |
| | Total fish /100 $m^2$ | | | | | | | 1.2 | 3.3 | 0.0 |
| East Branch means and totals: | | | | | | | | | | |
| 0+ fish/100 $m^2$ | Mean | | 6.7 | 0.0 | 2.5 | 36.1 | 6.5 | 2.1 | 5.6 | 5.7 |
| | SD | | ND | ND | ND | ND | ND | 3.0 | 6.0 | 6.8 |
| 1+ fish/100 $m^2$ | Mean | | 1.3 | 0.0 | 2.0 | 2.0 | 0.0 | 4.5 | 4.5 | 2.4 |
| | SD | | NA | NA | NA | NA | NA | 2.3 | 2.9 | 3.0 |
| 2+ fish/100 $m^2$ | Mean | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.7 |
| | SD | | NA | NA | NA | NA | NA | 0.0 | 0.0 | 3.1 |
| Total fish/100 $m^2$ | Mean | | 8.0 | 0.0 | 4.6 | 38.1 | 6.5 | 6.6 | 10.2 | 8.1 |
| | SD | | NA | NA | NA | NA | NA | 4.2 | 8.2 | 9.4 |
| | N | | 1 | 1 | 1 | 1 | 1 | 4 | 4 | 4 |
| Area ($m^2$) | 40,686 | | | | | | | | | |
| Population | 0+ fish | | 2,714 | 0 | 1,035 | 14,672 | 2,647 | 854 | 2,286 | 2,319 |
| | 1+ fish | | 521 | 0 | 826 | 834 | 0 | 1,822 | 1,849 | 991 |
| | 2+ fish | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,103 |
| | Total fish | | 3,235 | 0 | 1,861 | 15,505 | 2,647 | 2,677 | 4,135 | 3,310 |
| **Morell River means and totals**[b] | | | | | | | | | | |
| 0+ fish/100 $m^2$ | Mean | 0 | 8.38622 | 0 | 6.74566 | 32.698 | 7.06434 | 7.0614 | 9.16584 | 10.251 |
| | SD | 0 | 7.07679 | 0 | 4.50507 | 41.2241 | 8.27706 | 7.98196 | 7.37998 | 9.9776 |
| 1+ fish/100 $m^2$ | Mean | 3.38 | 2.68223 | 0.88283 | 4.34455 | 9.59815 | 1.36538 | 8.9555 | 7.3675 | 3.3245 |
| | SD | 2.2775 | 3.01008 | 0.88617 | 2.73479 | 11.0742 | 1.48496 | 10.3895 | 6.89209 | 4.2196 |
| 2+ fish/100 $m^2$ | Mean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3.9677 |
| | SD | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4.2554 |
| Total fish/100 $m^2$ | Mean | 3.38 | 11.0684 | 0.88283 | 11.0902 | 42.2961 | 8.42972 | 16.0169 | 16.5333 | 13.575 |
| | SD | 2.2775 | 8.40571 | 0.88617 | 6.61293 | 51.4658 | 7.78605 | 14.4806 | 12.6928 | 10.204 |
| | N | 5 | 4 | 4 | 6 | 6 | 6 | 14 | 14 | 13 |
| Area ($m^2$) | 237,176 | | | | | | | | | |
| Population | 0+ fish | 0 | 19,890 | 0 | 15,999 | 77,552 | 16,755 | 16,748 | 21,739 | 24,312 |
| | 1+ fish | 8,017 | 6,362 | 2,094 | 10,304 | 22,765 | 3,238 | 21,240 | 17,474 | 7,885 |
| | 2+ fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9,411 |
| | Total fish | 8,017 | 26,252 | 2,094 | 26,303 | 100,316 | 19,993 | 37,988 | 39,213 | 32,197 |

[a]Site boundaries in 1994-1996 are defined in Cairns et al. 1995. Except for Lower Leards, sites used in 1984-1985 are close to those repeated in 1994-1996, but boundaries may have shifted by several metres. Exact locations of 1975 sites were not recorded (L.A. Ducharme, pers. comm.). These sites are in the same general areas as those used later, but probably do not overlap with them.

[b]Calculations exclude Gill Road which is not accessible to ascending salmon due to the barriers at Mooneys Pond.

Table 14
Origin, biological characteristics, and potential egg deposition of the 1996 Morell River salmon run.

| | Small salmon | | | Large salmon | | | All salmon | | |
|---|---|---|---|---|---|---|---|---|---|
| | Wild | Hatch-ery | Total | Wild | Hatch-ery | Total | Wild | Hatch-ery | Total |
| Leards counts | 31 | 188 | 219 | 4 | 26 | 30 | 35 | 214 | 249 |
| Percent of all salmon | 12.4 | 75.5 | 88.0 | 1.6 | 10.4 | 12.0 | 14.1 | 85.9 | 100.0 |
| Number early (before 1 Sep) | 23 | 171 | 194 | 1 | 17 | 18 | 24 | 188 | 212 |
| Percent early | 74.2 | 91.0 | 88.6 | 25.0 | 65.4 | 60.0 | 68.6 | 87.9 | 85.1 |
| Mooneys counts | 4 | 95 | 99 | 0 | 4 | 4 | 4 | 99 | 103 |
| Percent of all salmon | 4 | 92 | 96 | 0 | 4 | 4 | 4 | 96 | 100 |
| Number early (before 1 Sep) | 4 | 95 | 99 | 0 | 4 | 4 | 4 | 99 | 103 |
| Percent early | 100.0 | 100.0 | 100.0 | N/A | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Number female | 2 | 25 | 27 | 0 | 1 | 1 | 2 | 26 | 28 |
| Percent female | 50.0 | 26.3 | 27.3 | N/A | 25.0 | 25.0 | 50.0 | 26.3 | 27.2 |
| Estimated number in run[a] | 239 | 1,450 | 1,689 | 31 | 200 | 231 | 270 | 1,650 | 1,920 |
| Estimated harvest | 56 | 341 | 397 | 0 | 0 | 0 | 56 | 341 | 397 |
| Estimated escapement | 183 | 1,109 | 1,292 | 31 | 200 | 231 | 214 | 1,309 | 1,523 |
| Estimated females in escapement[b] | 32 | 194 | 226 | 22 | 145 | 167 | 54 | 339 | 393 |
| Number of eggs deposited[c] | 100,577 | 609,949 | 710,526 | 110,376 | 717,445 | 827,821 | 210,953 | 1,327,394 | 1,538,347 |
| Percent of conservation requirement[d] | 18 | 107 | 125 | 19 | 126 | 145 | 37 | 233 | 270 |

[a]Total run = (1995 total run estimated by mark-recapture)*(1996 total Leards count)/(1995 total Leards count)
The estimated 1996 run is partitioned into origin and size classes according to the proportions in Leards samples

[b]Based on 17.5% females among small salmon and 72.1% females among large salmon

[c]Based on fecundities of 3,143 for small salmon and 4,963 for large salmon

[d]Conservation requirement is 569,222 eggs, based on 2.4 eggs·$m^2$ in 237,176 $m^2$ of habitat

Table 15

Return rates of Atlantic salmon stocked in PEI rivers. Fish from the Cardigan SEC and Profitts Pond, hatched in 1983-1985 and released above Leards Dam, were distinguished on their return by nose tagging.

| Hatching year (Yr) | Number and origin of fish stocked[a] | | | | Salmon returning[b] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Small salmon in Yr+3 | | Large salmon in Yr+4 | | Both sizes, Yr+3 and Yr+4 | | Both sizes, from semi-natural 2+ smolts only |
| | 0+ parr in Yr | 1+ parr in Yr+1 | 1+ smolts in Yr+2 | 2+ parr & smolts in Yr+2 | Number | Percent re-turning | Number | Percent re-turning | Number | Percent re-turning | Percent returning |
| Morell above Leards Dam[c] | | | | | | | | | | | |
| From direct fishway counts: | | | | | | | | | | | |
| 1983 | 9,000 C | | | 10,428 C | 96 | 0.5 | 10 | 0.1 | 106 | 0.5 | |
| | | | | 10,997 P | 523 | 4.8 | 56 | 0.5 | 579 | 5.3 | 5.3 |
| 1984 | | | | 1,529 C | 74 | 4.8 | 6 | 0.4 | 80 | 5.2 | |
| | | | | 13,099 P | 1,094 | 8.4 | 79 | 0.6 | 1,173 | 9.0 | 9.0 |
| 1985 | | | | 3,055 C | 84 | 2.7 | 1 | 0.0 | 85 | 2.8 | |
| | | | | 25,729 P | 1,302 | 5.1 | 124 | 0.5 | 1,426 | 5.5 | 5.5 |
| 1986 | | | 4,405 C | 10,173 P | 323 | 2.2 | 59 | 0.4 | 382 | 2.6 | 3.8 |
| 1987 | | | | 10,225 P | 365 | 3.6 | 28 | 0.3 | 393 | 3.8 | 3.8 |
| 1988 | | | | 48,873 M | 294 | 0.6 | 38 | 0.1 | 332 | 0.7 | 0.7 |
| 1989 | | | | 26,656 M | 843 | 3.2 | 11 | 0.0 | 854 | 3.2 | 3.2 |
| 1990 | | | | 40,702 M | 584 | 1.4 | 27 | 0.1 | 611 | 1.5 | 1.5 |
| 1991 | | 2,200 M | 19,379 C | | 28 | 0.1 | 10 | 0.0 | 38 | 0.2 | |
| 1992 | | | | 15,317 M | 172 | 1.1 | 26 | 0.2 | 198 | 1.3 | 1.3 |
| 1993 | | | | 7,822 M | 188 | 2.4 | N/A | N/A | | | 0.0 |
| Fishway counts adjusted for trapping efficiency:[d] | | | | | | | | | | | |
| 1991 | | 2,200 M | 19,379 C | | 70 | 0.3 | 25 | 0.12 | 95 | 0.4 | |
| 1992 | | | | 15,317 M | 430 | 2.8 | 65 | 0.42 | 495 | 3.2 | 3.2 |
| 1993 | | | | 7,822 M | 470 | 6.0 | N/A | N/A | | | |
| Entire Morell[e] | | | | | | | | | | | |
| 1990 | | | | 45,622 | N/A | N/A | 208 | 0.5 | | | |
| 1991 | | 2,200 M | 19,379 C | | 216 | 1.0 | 77 | 0.4 | 293 | 1.4 | |
| 1992 | | | | 26,000 M | 1,326 | 5.1 | 200 | 0.8 | 1,526 | 5.9 | 5.9 |
| 1993 | | | | 15,568 M | 1,450 | 9.3 | N/A | N/A | | | |
| Mill River | | | | | | | | | | | |
| 1987 | | | | 3,065 P | 176[f] | 5.7 | | | 176 | 5.7 | 5.7 |
| 1990 | | | | 3,826 P | 17 | 0.4 | 0 | 0.0 | 17 | 0.4 | 0.4 |
| 1991 | | | | 2,972 P | 11 | 0.4 | 27 | 0.9 | 38 | 1.3 | 1.3 |
| 1992 | | | | 2,711 P | 3 | 0.1 | N/A | N/A | | | |
| West River | | | | | | | | | | | |
| 1986 | | | 1,390 C | | 31 | 2.2 | 23 | 1.7 | 54 | 3.9 | |
| 1987 | | | | 1,324 P | 25 | 1.9 | N/A | N/A | | | |
| 1990 | | | | 11,481 MP | 248 | 2.2 | 6 | 0.1 | 254 | 2.2 | 2.2 |
| 1991 | 50,750 C | 10,173 M | | | 4 | 0.0 | N/A | N/A | | | |
| Valleyfield River | | | | | | | | | | | |
| 1987 | 0 | 0 | 6,299 C | 0 | 36 | 0.57 | 0 | 0.00 | 36 | 0.57 | |
| 1988 | 0 | 2,491 C | 738 C | 0 | 5 | 0.15 | 0 | 0.00 | 5 | 0.15 | |
| 1989 | 0 | 0 | 5,259 C | 0 | 25 | 0.48 | 0 | 0.00 | 25 | 0.48 | |
| 1990 | 89,003 C | 0 | 0 | 12,000 MC | 84 | 0.08 | 7 | 0.01 | 91 | 0.09 | |
| 1991 | 55,723 C | 10,014 M | 0 | 0 | 15 | 0.02 | 4 | 0.01 | 19 | 0.03 | |
| 1992 | 32,494 C | 28,898 C | 5,896 C | 1,980 M | 58 | 0.08 | 8 | 0.01 | 66 | 0.10 | 3.3 |
| 1993 | 14,467 C | | | 15,517 CGM | 75 | 0.25 | N/A | N/A | | | 0.5 |

[a]Origins are Profitts Pond (P), Cardigan Salmonid Enhancement Centre (C), Mooneys Pond (M), and Gilberts Pond (G)

[b]Counts include hatchery fish only, where origin of fish was recorded. Return rates for the Mill, West, and the Valleyfield are minimal values as some angling takes place below the traps.

[c]Stocking numbers are fish released above Leards Dam, return numbers are hatchery fish counted at Leards Pond fishway

[d]Fishway counts are adjusted for trapping efficiency measured in 1996 (40.0%)

[e]Stocking numbers are the total released in the Morell watershed, return numbers are hatchery-reared fish estimated from the 1995 mark-recapture experiment.

Table 16
Number of salmon stocked above Leards Dam, number of salmon counted at Leards fishway trap and released in Leards Pond, and number of salmon redds counted above Leards Pond.

| Hatching year (Yr) | Number and origin of fish stocked[a] | | | | Number of salmon counted at Leards fishway and released in pond | | | Redds in Yr+3 |
|---|---|---|---|---|---|---|---|---|
| | 1+ parr in Yr+1 | 1+ smolts in Yr+2 | 2+ parr & smolts in Yr+2 | Total for cohort | Small salmon in Yr+3 | Large salmon in Yr+4 | Total salmon in Yr+3 | |
| 1987 | | | 10225 P | 10225 | 368 | 14 | 412 | 365 |
| 1988 | | | 48,873 M | 48873 | 280 | 14 | 294 | 295 |
| 1989 | | | 26,656 M | 26656 | 824 | 0 | 838 | 650 |
| 1990 | | | 40,702 M | 40702 | 461 | 3 | 461 | 215 |
| 1991 | 2,200 M | 19,379 C | | 21579 | 2 | 2 | 5 | N/A |
| 1992 | | | 15,317 M | 15317 | 130 | 20 | 132 | 190 |
| 1993 | | | 7,822 M | 7822 | 169 | N/A | 189 | 308 |

[a]Origins are Profitts Pond (P), Cardigan Salmonid Enhancement Centre (C), and Mooneys Pond (M)

Table 17
Return rates of wild Atlantic salmon to the Morell River, based on juvenile populations estimated from electrofishing surveys.

| Hatching year (Yr) | Estimated popuation, survey date | | | | Wild salmon returning | | | Returns as a percent of population |
|---|---|---|---|---|---|---|---|---|
| | 0+ parr in Yr | | 1+ parr in Yr+1 | | Small salmon in Yr+3 | Large salmon in Yr+4 | Total returns from cohort | |
| Morell above Leards - from direct fishway counts | | | | | | | | |
| 1983 | | | 473 | Aug-Sep 84 | 1 | 2 | 3 | 0.634 |
| 1984 | 0 | Aug-Sep 84 | | | 2 | 2 | 4 | Not calculable |
| 1984 | | | 2,037 | Aug-Sep 85 | 2 | 2 | 4 | 0.196 |
| 1985 | 0 | Aug-Sep 85 | | | 8 | 0 | 8 | Not calculable |
| 1993 | | | 23,058 | Aug-Sep 94 | 31 | N/A | 31 | 0.134 |
| 1993 | | | 0 | Dec-94 | 31 | N/A | 31 | Not calculable |
| Morell above Leards - adjusted fishway counts | | | | | | | | |
| 1993 | | | 23,058 | Aug-Sep 94 | 78 | N/A | 78 | 0.338 |
| 1993 | | | 0 | Dec 94 | 78 | N/A | 78 | Not calculable |
| Entire Morell | | | | | | | | |
| 1993 | | | 22,765 | Aug-Sep 94 | 239 | N/A | 239 | 1.050 |
| 1993 | | | 3,238 | Dec 94 | 239 | N/A | 239 | 7.381 |

Table 18
Exploitation rates (sport and Native) of small Atlantic salmon returning to PEI rivers.

| River | Number of small salmon entering river[a] | | | Retained catch of small salmon[a] | | | Percent exploitation | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1994 | 1995 | 1996 | 1994 | 1995 | 1996 | 1994 | 1995 | 1996 |
| Morell | 262 | 1352 | 1689 | 89 | 469 | 397 | 34.0 | 34.7 | 23.5 |
| Dunk | | 40 | | | 0 | | | 0.0 | |
| Valleyfield | 15 | 58 | 75 | 5 | 16 | 36 | 33.3 | 27.6 | 48.0 |

[a]1994 and 1996 estimates of small salmon entering the Morell are based on the 1995 mark-recapture estimate, adjusted by the ratio of small salmon counted at Leards in these years: small salmon counted at Leards in 1995. Dunk and Valleyfield numbers are from trap counts.
[b]From an angler mail-out survey (1994) and licence stub surveys (1995-1996).

Table 19
Atlantic salmon entering Leards Pond and their potential egg depositions, 1981-1996. Potential egg depositions are not adjusted for human harvests.

| Year | Total entering Leards Pond | | Potential egg deposition above Leards Pond[a] | | | |
|---|---|---|---|---|---|---|
| | Small salmon | Large salmon | From small salmon | From large salmon | Total | Percent of conservation requirement |
| From direct fishway counts | | | | | | |
| 1981 | 39 | 6 | 21,451 | 21,470 | 42,921 | 24 |
| 1982 | 33 | 3 | 18,151 | 10,735 | 28,886 | 16 |
| 1983 | 2 | 2 | 1,100 | 7,157 | 8,257 | 5 |
| 1984 | 5 | 4 | 2,750 | 14,313 | 17,063 | 10 |
| 1985 | 14 | 1 | 7,700 | 3,578 | 11,279 | 6 |
| 1986 | 278 | 3 | 339,444 | 14,889 | 354,333 | 198 |
| 1987 | 658 | 54 | 361,916 | 193,229 | 555,146 | 310 |
| 1988 | 1,290 | 20 | 709,532 | 71,566 | 781,099 | 436 |
| 1989 | 330 | 48 | 181,508 | 171,760 | 353,268 | 197 |
| 1990 | 368 | 44 | 202,409 | 157,446 | 359,855 | 201 |
| 1991 | 280 | 14 | 154,007 | 50,097 | 204,104 | 114 |
| 1992 | 824 | 14 | 453,221 | 50,097 | 503,317 | 281 |
| 1993 | 461 | 0 | 253,562 | 0 | 253,562 | 141 |
| 1994 | 2[b] | 3[c] | 3,143 | 14,889 | 18,032 | 10 |
| 1995 | 130 | 2[b] | 71,503 | 4,963 | 76,466 | 43 |
| 1996 | 169 | 20 | 92,954 | 49,630 | 142,584 | 80 |
| Fishway counts adjusted for trapping efficiency[d] | | | | | | |
| 1994 | 56 | 47 | 30,851 | 115,570 | 146,421 | 82 |
| 1995 | 409 | 25 | 225,216 | 60,890 | 286,106 | 160 |
| 1996 | 498 | 65 | 273,939 | 161,484 | 435,423 | 243 |

[a]Based on fecundities from Davidson and Bielak 1992 and sex ratios from Davidson and Bielak 1992 and Cairns et al. 1995
[b]1 male, 1 female
[c]All females
[d]Fishway counts are adjusted for trapping efficiency as calculated for 1996

Table 20
Potential egg deposition by Atlantic salmon in the Morell, Mill, Dunk, West, and Valleyfield Rivers.

| Year | Total returns | | Escapement | | Egg deposition[a] | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Small salmon | Large salmon | Small salmon | Large salmon | Small salmon | Large salmon | Total | Conservation requirement | Percent of requirement |
| Morell River | | | | | | | | | |
| 1994 | 278 | 223 | 189 | 223 | 103,955 | 797,966 | 901,921 | 569,222 | 158 |
| 1995 | 1,434 | 116 | 966 | 115 | 531,324 | 411,507 | 942,831 | 569,223 | 166 |
| 1996 | 1,689 | 231 | 1,292 | 231 | 710,632 | 826,593 | 1,537,225 | 569,224 | 270 |
| Mill River | | | | | | | | | |
| 1993[b] | 17 | 5 | | | 9,350 | 17,892 | 27,242 | 139,920 | 19 |
| 1995 | 3 | 27 | 3 | 27 | 1,650 | 96,615 | 98,265 | 139,920 | 70 |
| Dunk River | | | | | | | | | |
| 1995 | 40 | 0 | 40 | 0 | 22,001 | 0 | 22,001 | 463,387 | 5 |
| West River | | | | | | | | | |
| 1989[b] | 31 | 19 | | | 17,051 | 67,988 | 85,039 | 442,800 | 19 |
| 1990[b] | 25 | 23 | | | 13,751 | 82,301 | 96,052 | 442,800 | 22 |
| 1993[b] | 250 | 12 | | | 137,506 | 42,940 | 180,446 | 442,800 | 41 |
| Valleyfield River | | | | | | | | | |
| 1990[b] | 36 | 0 | | | 19,801 | 0 | 19,801 | 306,000 | 6 |
| 1991[b] | 5 | 0 | | | 2,750 | 0 | 2,750 | 306,000 | 1 |
| 1992[b] | 25 | 0 | | | 13,751 | 0 | 13,751 | 306,000 | 4 |
| 1993[b] | 84 | 0 | | | 46,202 | 0 | 46,202 | 306,000 | 15 |
| 1994 | 15 | 7 | 10 | 7 | 5,500 | 25,048 | 30,549 | 306,000 | 10 |
| 1995 | 58 | 4 | 55 | 4 | 30,251 | 14,313 | 44,565 | 306,000 | 15 |
| 1996 | 75 | 8 | 39 | 8 | 21,451 | 28,627 | 50,078 | 306,000 | 16 |

[a]Based on fecundities from Davidson and Bielak 1992 and sex ratios from Davidson and Bielak 1992 and Cairns et al. 1995

[b]Egg deposition calculated from total returns because escapements are unavailable

Table 21
Potential runs of wild Atlantic salmon on the Morell River, based on various scenarios.

| Scenario | Wild run size | | | Small wild run as a percent of recent harvests[a] | Wild run as percent of estimated total run, 1995-1996[b] | Percent of conservation requirement[c] |
|---|---|---|---|---|---|---|
| | Small | Large | Total | | | |
| Wild runs estimated for 1994-1996 | | | | | | |
| 1994 | 62 | 15 | 77 | 15 | 4 | 15 |
| 1995 | 108 | 39 | 147 | 26 | 8 | 35 |
| 1996 | 239 | 31 | 270 | 57 | 16 | 43 |
| Wild escapement equals conservation requirement, small:large ratio from the mean of Leards in 1986-1996, fecundity and sex ratios as in Table 14 | | | | | | |
| Run equals escapement (no fishing mortality) | 369 | 102 | 471 | 87 | 27 | 100 |
| 30% exploitation rate of small fish | 413 | 114 | 527 | 98 | 30 | 100 |
| Returns calculated from 1996 smolt fence, assumes 5% will return as 1SW small salmon and 0.3% will return as 2SW large salmon | | | | | | |
| Minimum estimate of wild smolt exodus (1,696) | 85 | 5 | 90 | 20 | 5 | 11 |
| Maximum estimate of wild smolt exodus (4,874) | 244 | 15 | 258 | 58 | 15 | 33 |
| Returns calculated from estimated populations of 1+ juveniles from electrofishing surveys, assuming 0.5 overwinter survival, sea exodus at age 2+, 5% survival to 1SW small, and 0.3% survival to 2SW large | | | | | | |
| Surveys in Sep 1975 (8,033) (excludes East Branch) | 201 | 12 | 213 | 47 | 12 | 27 |
| Surveys in Aug-Sep 1984 (8,330) | 208 | 12 | 221 | 49 | 13 | 28 |
| Surveys in Aug-Sep 1995 (10,043) | 251 | 15 | 266 | 59 | 15 | 34 |
| Surveys in Aug-Sep 1994 (25,429) | 636 | 38 | 674 | 150 | 39 | 85 |
| Surveys in Dec 1994 (3,167) | 79 | 5 | 84 | 19 | 5 | 11 |
| Surveys in Jul-Aug 1995 (19,028) | 476 | 29 | 504 | 112 | 29 | 64 |
| Surveys in Oct-Nov 1995 (16,839) | 421 | 25 | 446 | 100 | 26 | 57 |
| Surveys in Aug-Sep 1996 (10,166) | 254 | 15 | 269 | 60 | 16 | 34 |
| Mean of surveys (12,629) | 316 | 19 | 335 | 75 | 19 | 42 |

[a]Mean of retained catches, 1995-1996, from stub surveys (423)

[b]Mean of estimated total runs, 1995-1996 (1,735)

[c]Assumes no angling mortality except where noted. Fecundities and sex ratios from Table 14.

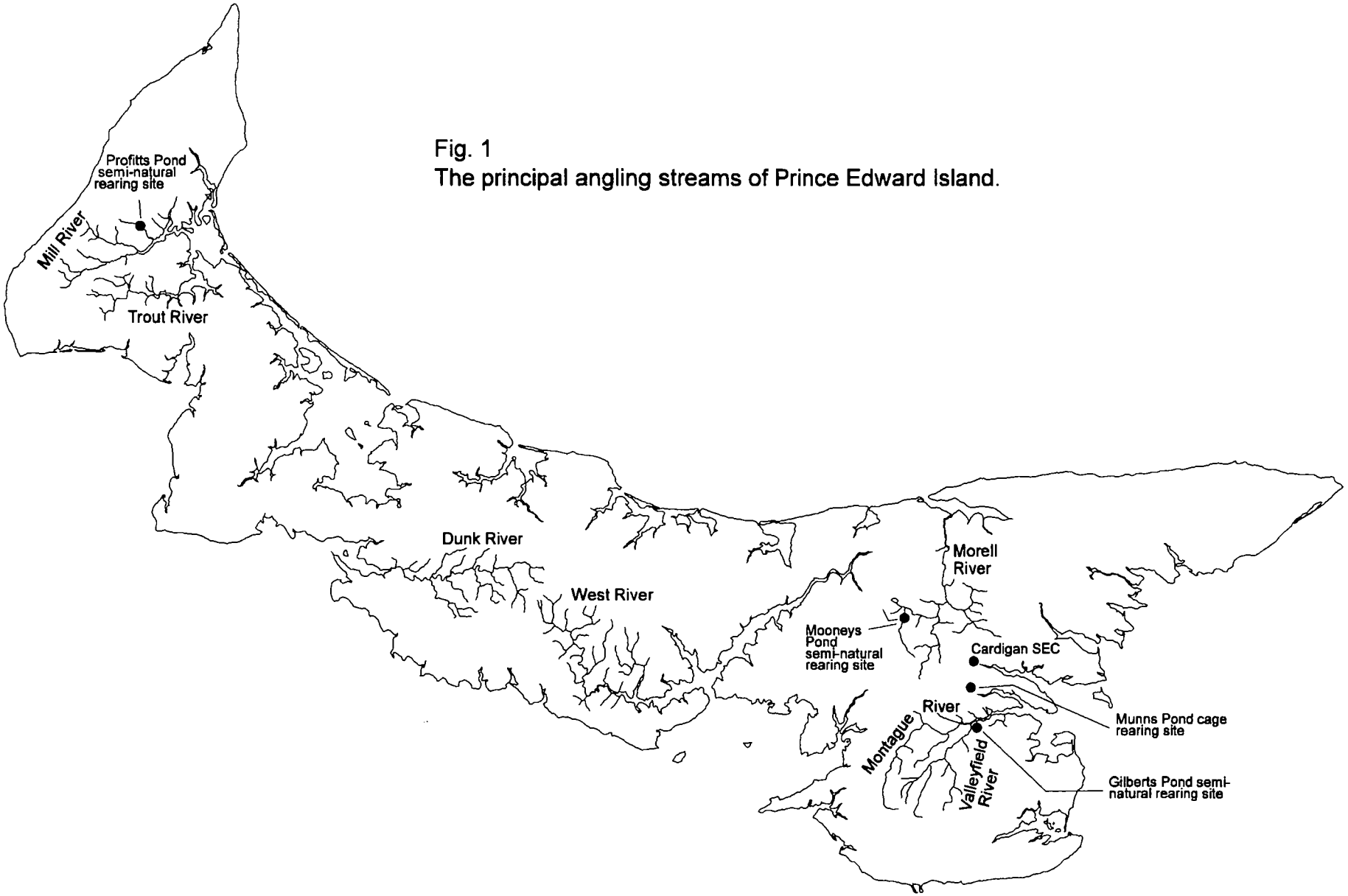
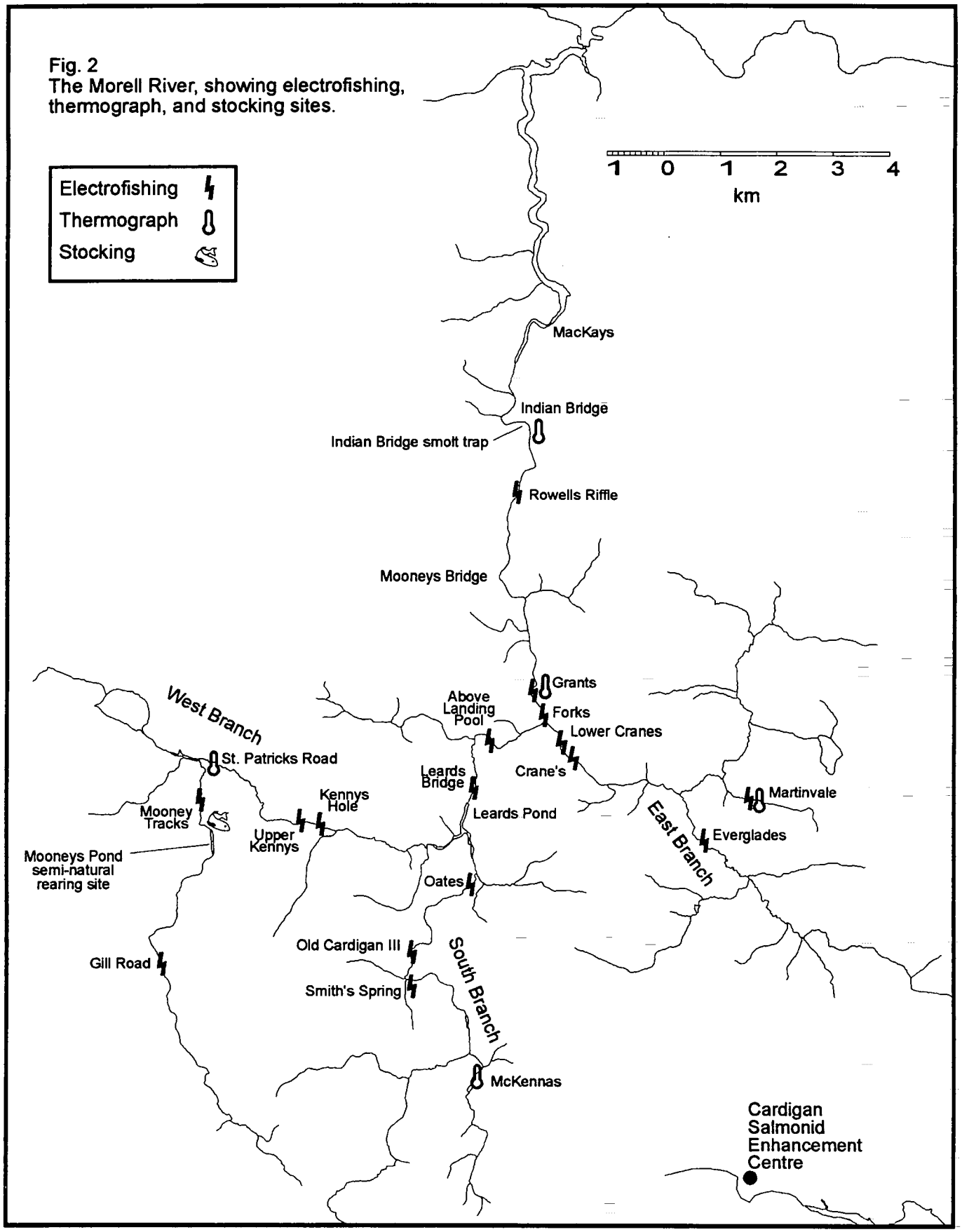



Fig. 1
The principal angling streams of Prince Edward Island.

Fig. 2
The Morell River, showing electrofishing, thermograph, and stocking sites.



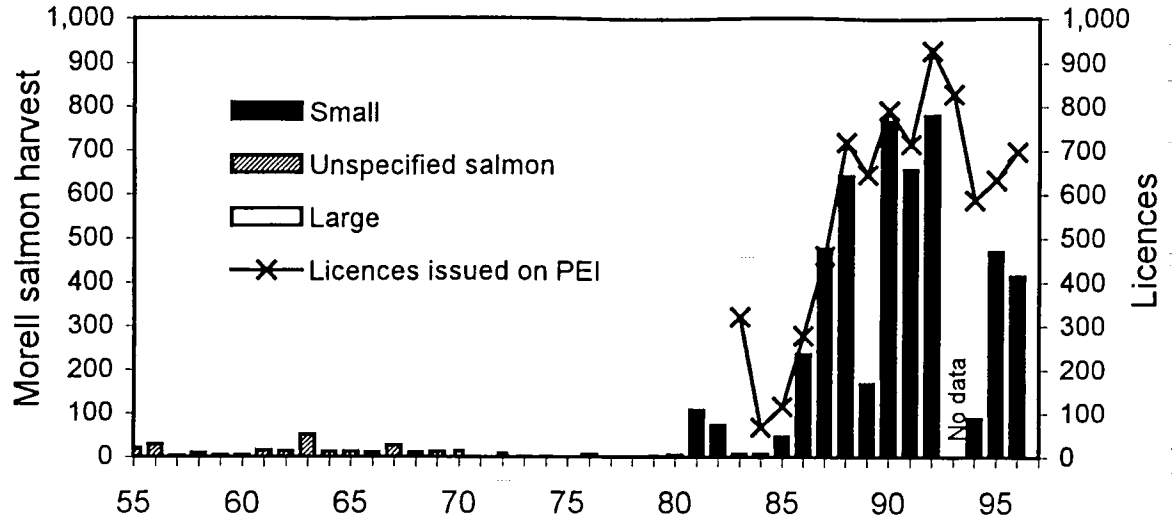



Fig. 3

Atlantic salmon sport catches on the Morell River, and PEI salmon licence sales, 1983-1996.

## 1996 Salmon Report Card

№ 000629

Please complete and return this card at the end of the fishing season, even if you did not fish for salmon in 1996.

Fill in a new line each day you fish for salmon. If you don't catch any, enter zeros for your catch.

If you run out of space, write the information on a separate sheet of paper. Put the paper in an envelope and tape this card to it. No postage is required.

Check here if you did not fish for salmon in 1996. ☐

| Mo. | Date | River | Grilse | | Large salmon: Number caught & released |
|---|---|---|---|---|---|
| | | | Number caught & kept | Number caught & released | |
| Jun. | 18 | Example River | 1 | 2 | 0 |
| Jun. | 27 | Example River | 0 | 0 | 2 |

## Daily salmon log 1996

Please indicate the number of grilse and large salmon you caught during each fishing day.

If you fished and didn't catch anything, enter zero for your catch.

№ 000629

| Mo. | Date | River | Grilse | | Large salmon: Number caught & released |
|---|---|---|---|---|---|
| | | | Number caught & kept | Number caught & released | |
| Jun. | 18 | Example River | 1 | 2 | 0 |
| Jun. | 27 | Example River | 0 | 0 | 2 |

## Seasonal summary 1996

Check here if you did not fish for salmon on PEI in 1996. ☐

| River | Number of days fishing for salmon | Grilse | | Large salmon: Number caught & released |
|---|---|---|---|---|
| | | Number caught & kept | Number caught & released | |
| Example River | 25 | 7 | 12 | 5 |
| Mordl River | | | | |
| Mill River | | | | |
| Trout R. (Prince Co.) | | | | |
| Dunk River | | | | |
| West River | | | | |
| Valleyfield River | | | | |
| Other _____ | | | | |
| Other _____ | | | | |

Fig. 4

Stub attached to 1996 PEI salmon licences (left), and reminder card sent to licence-holders who did not return their stubs (right).

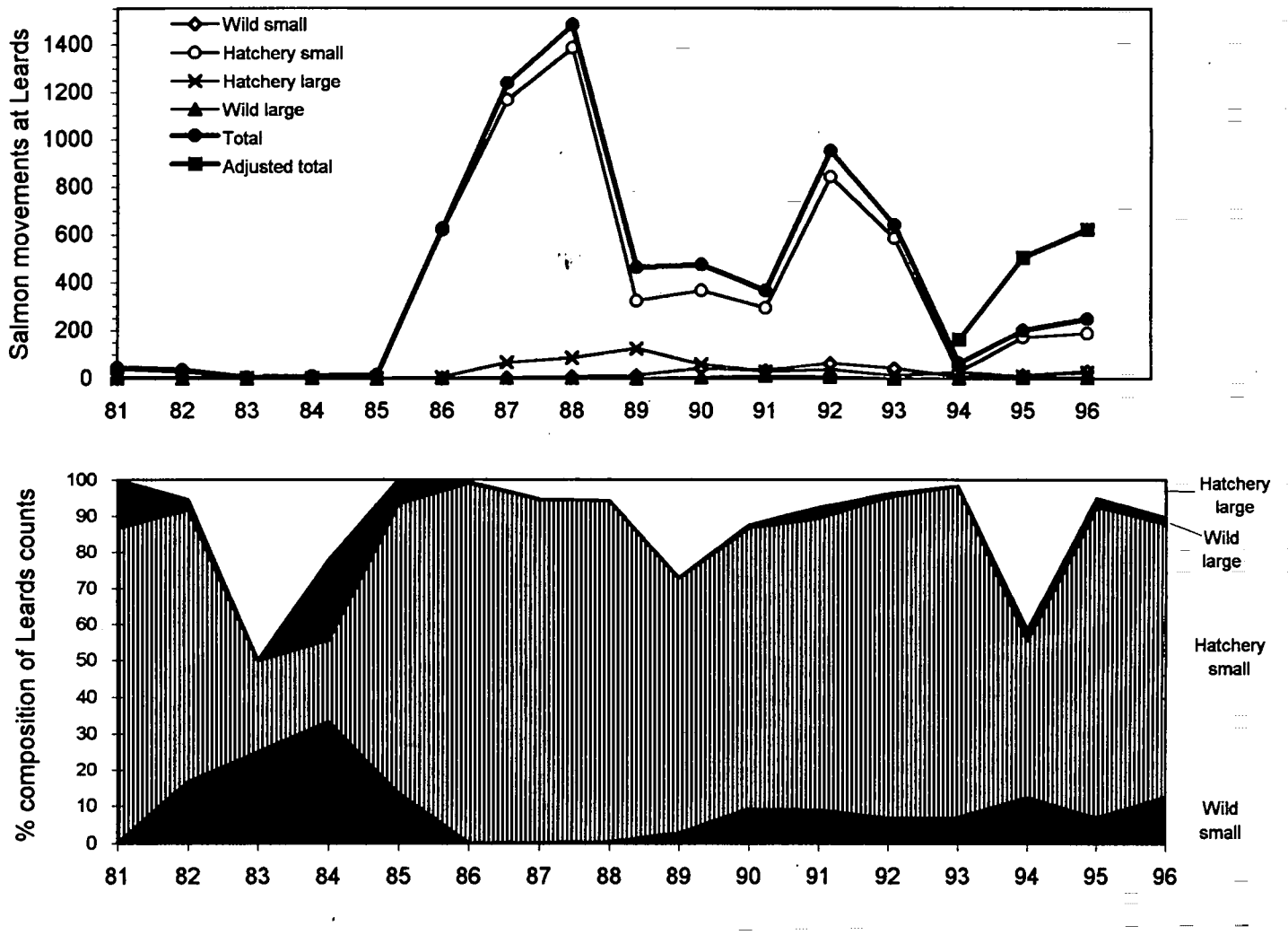



Fig. 5
Atlantic salmon returns to Leards fishway, 1981-1996, and return composition by origin and size.
"Adjusted total" estimates total movements, based on trap efficiency measured in 1996.

Fig. 6

Run timing of hatchery (upper panels) and wild (lower panels) salmon ascending the Leards Pond fishway, 1985-1996.

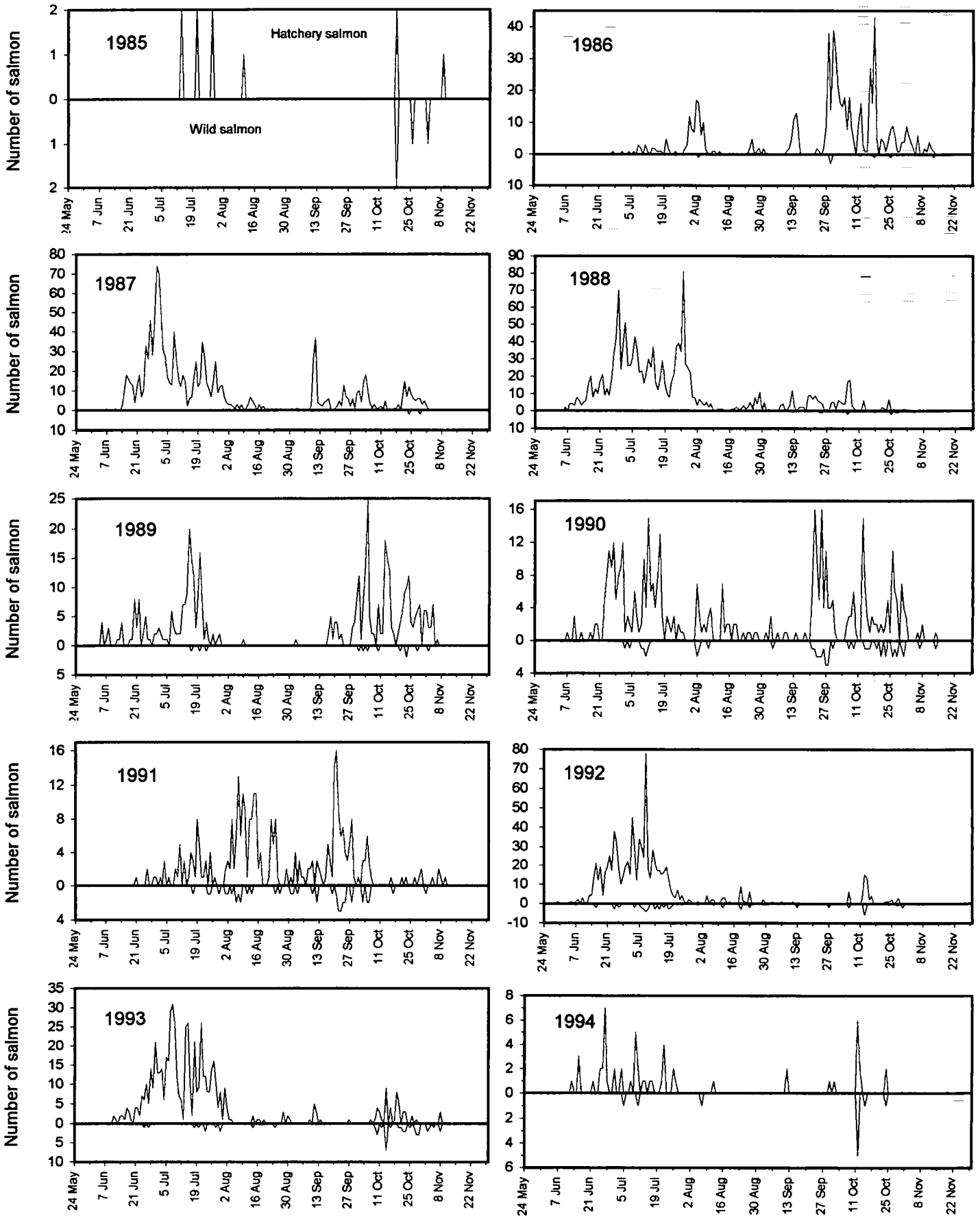
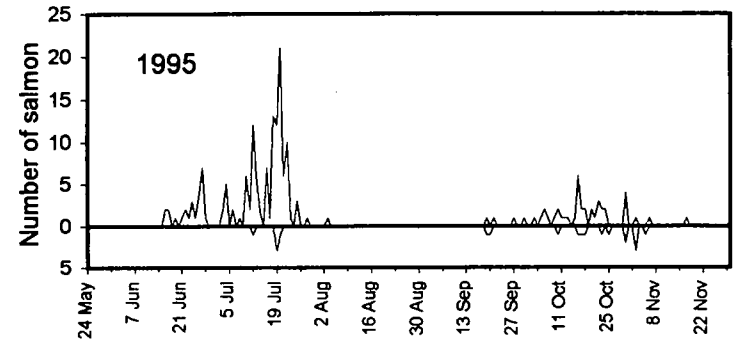
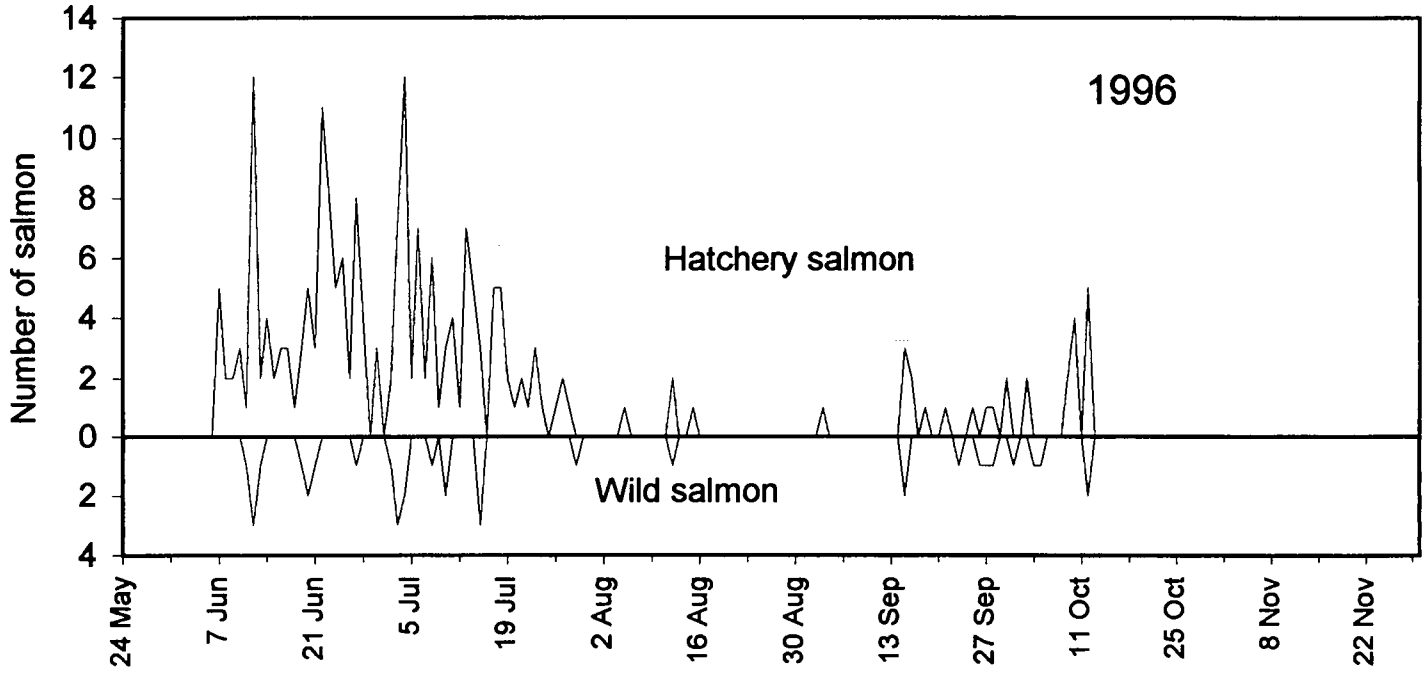
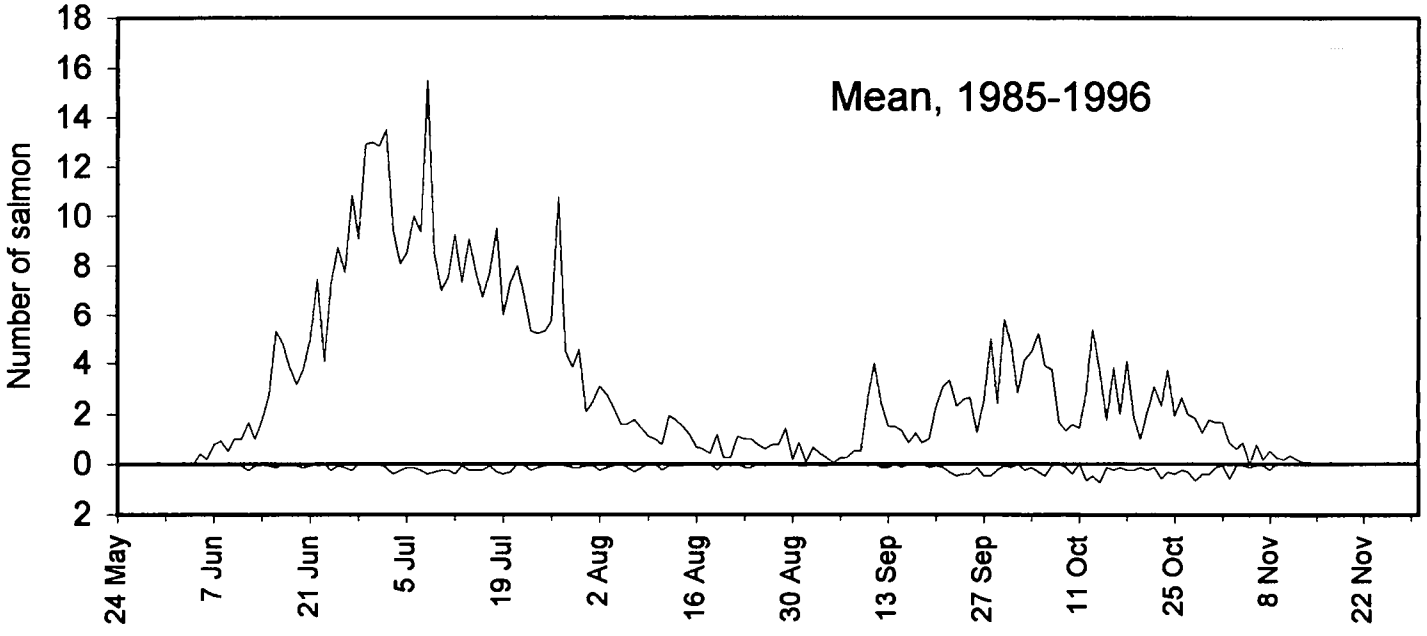


Fig. 6 (continued)



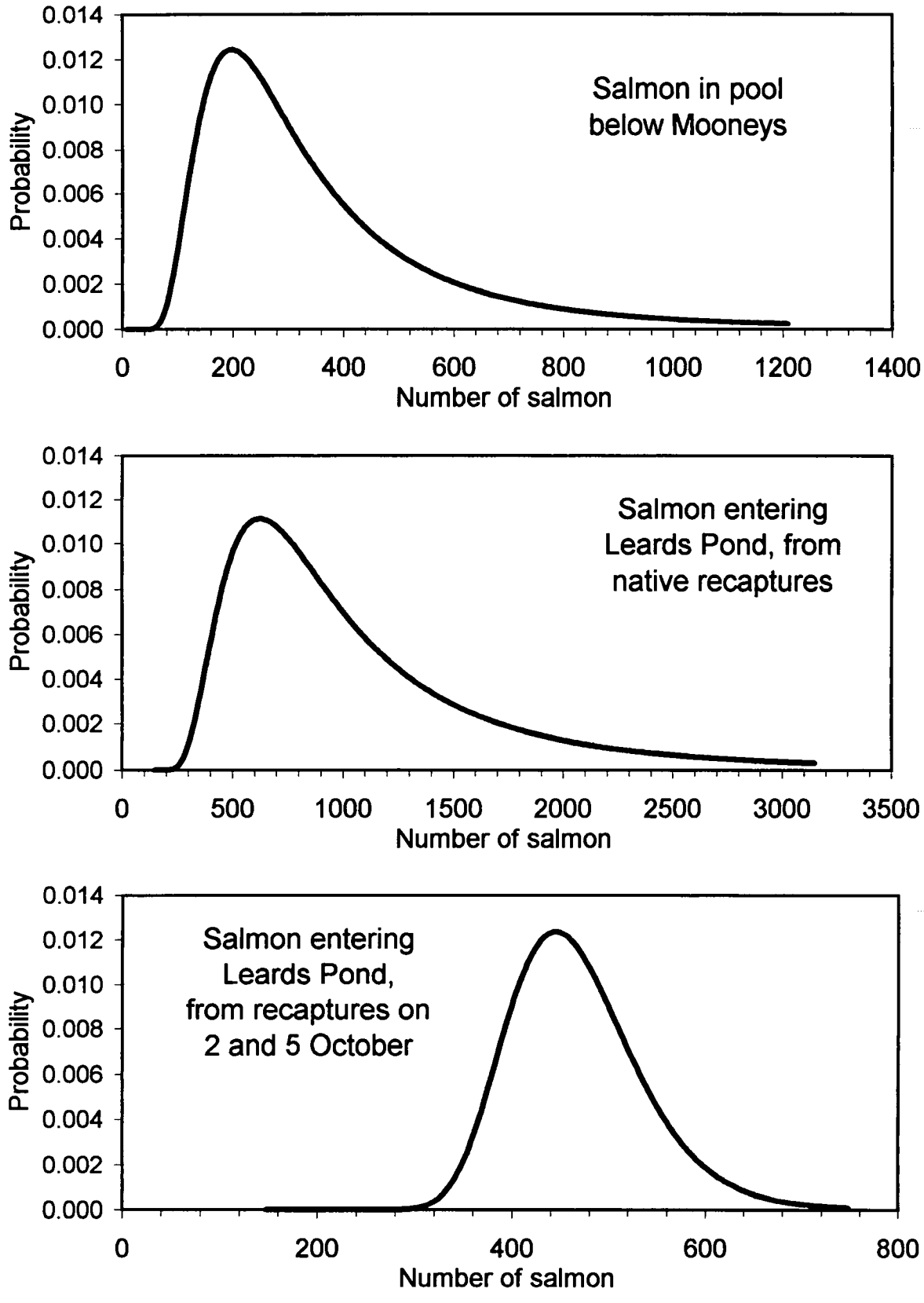



Fig. 7
Bayesian probability distributions of salmon numbers from mark-recapture experiments on the Morell River, 1996.

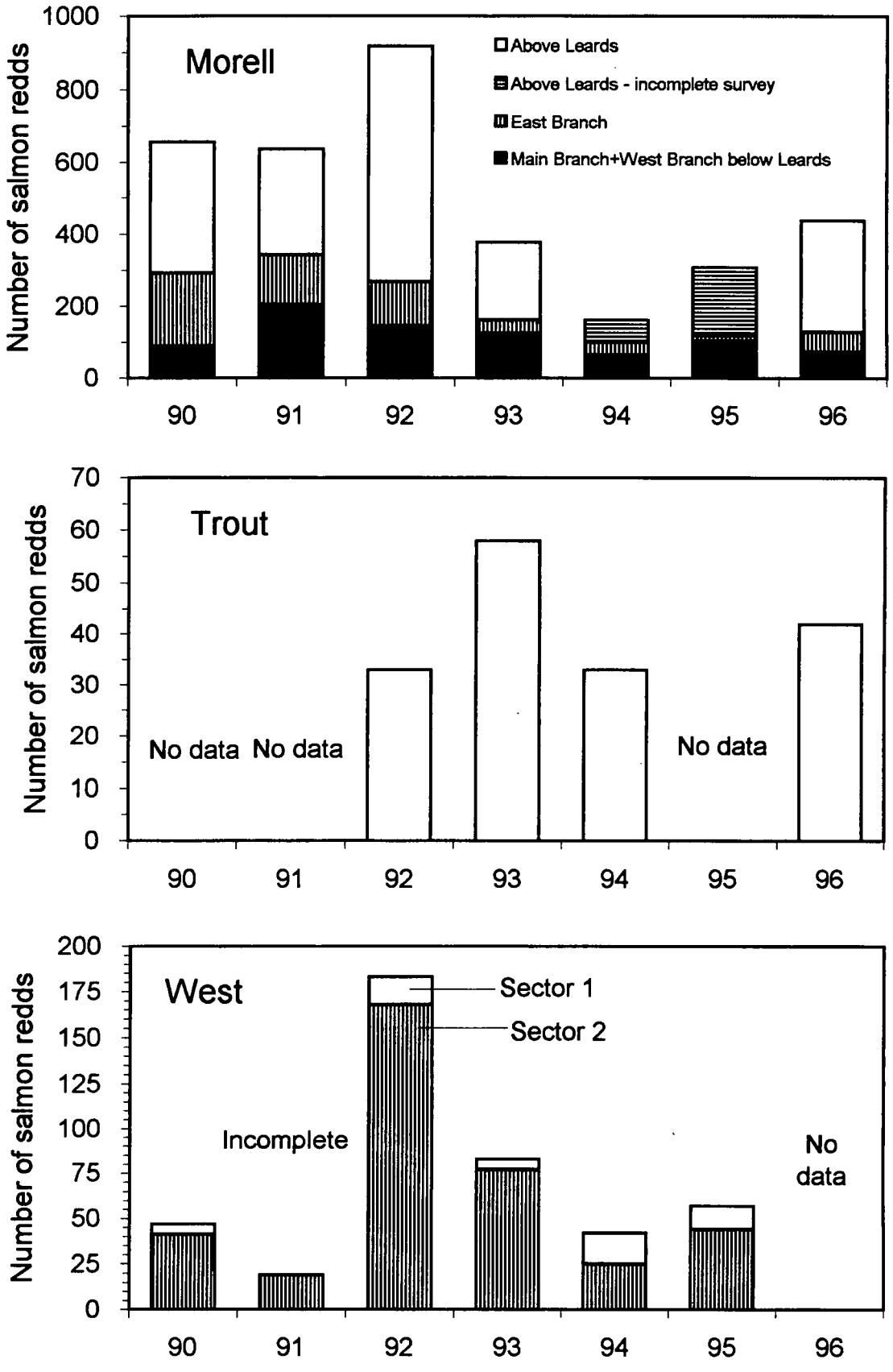



Fig. 8
Counts of Atlantic salmon redds in the Morell, Trout, and West Rivers. Data from D.L. Guignion, D. Biggar, C. Crane, T. Dupuis, and R. MacFarlane.

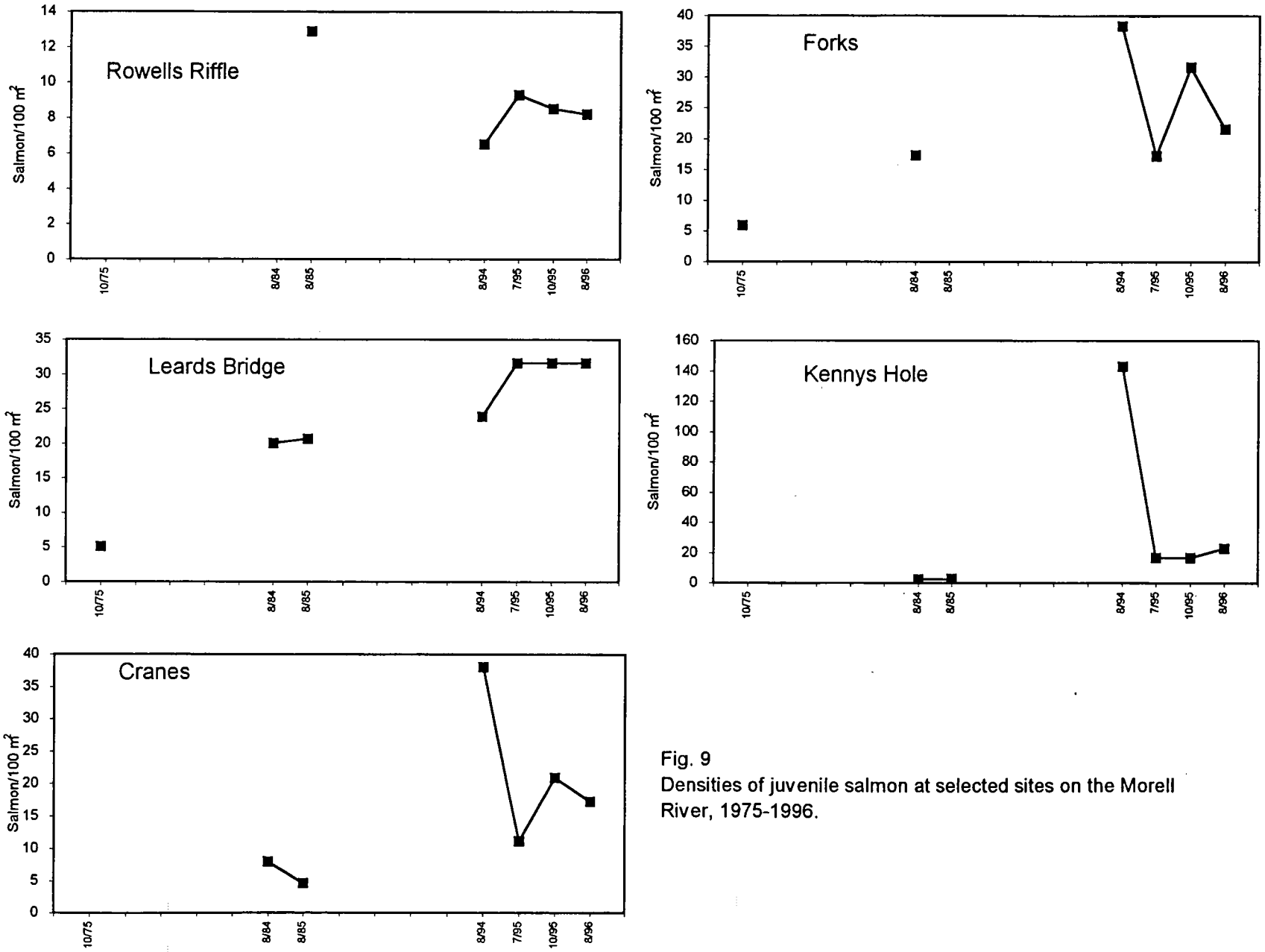



Fig. 9
Densities of juvenile salmon at selected sites on the Morell River, 1975-1996.

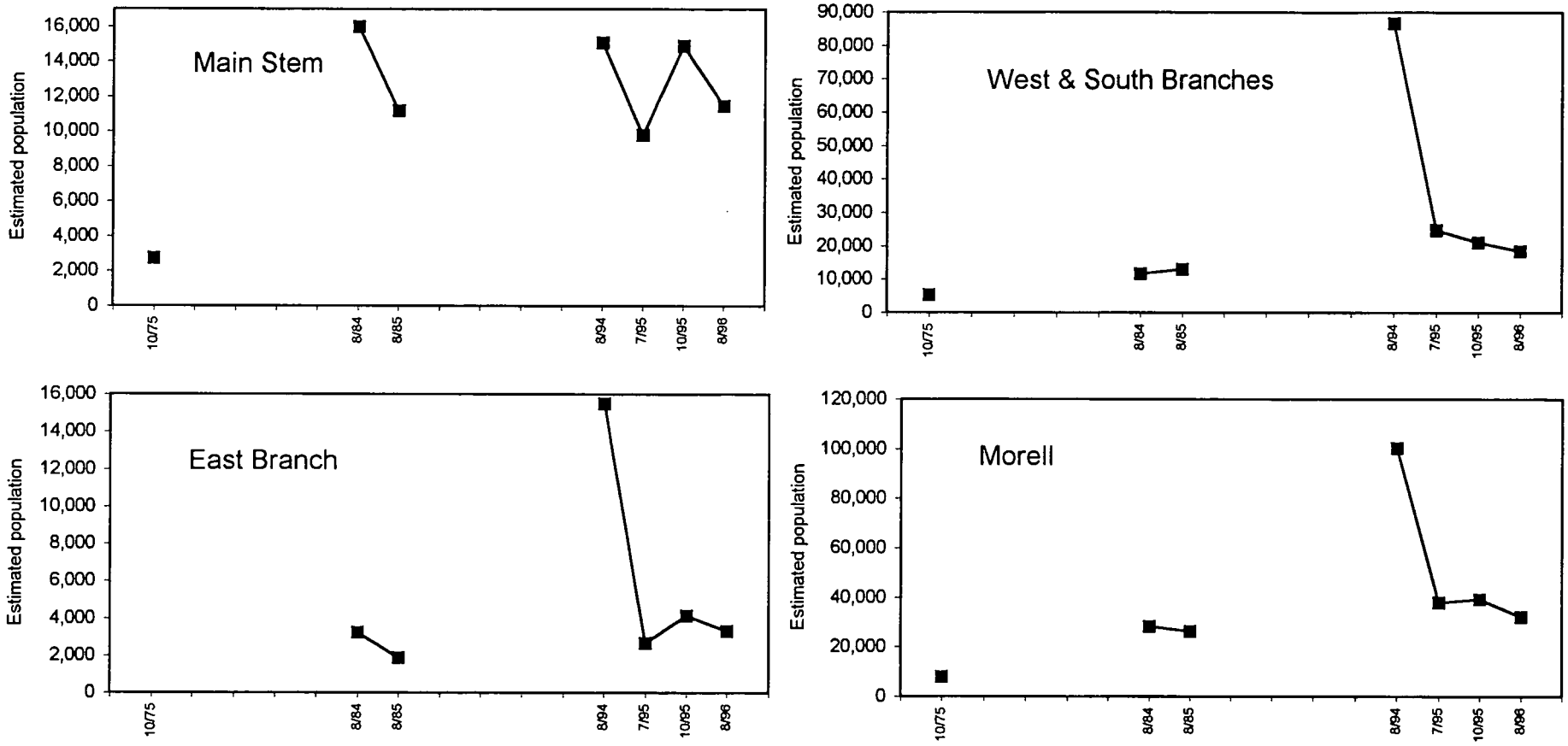



Fig. 10
Estimated populations of juvenile salmon in the Morell River, 1975-1996, based on electrofishing surveys.

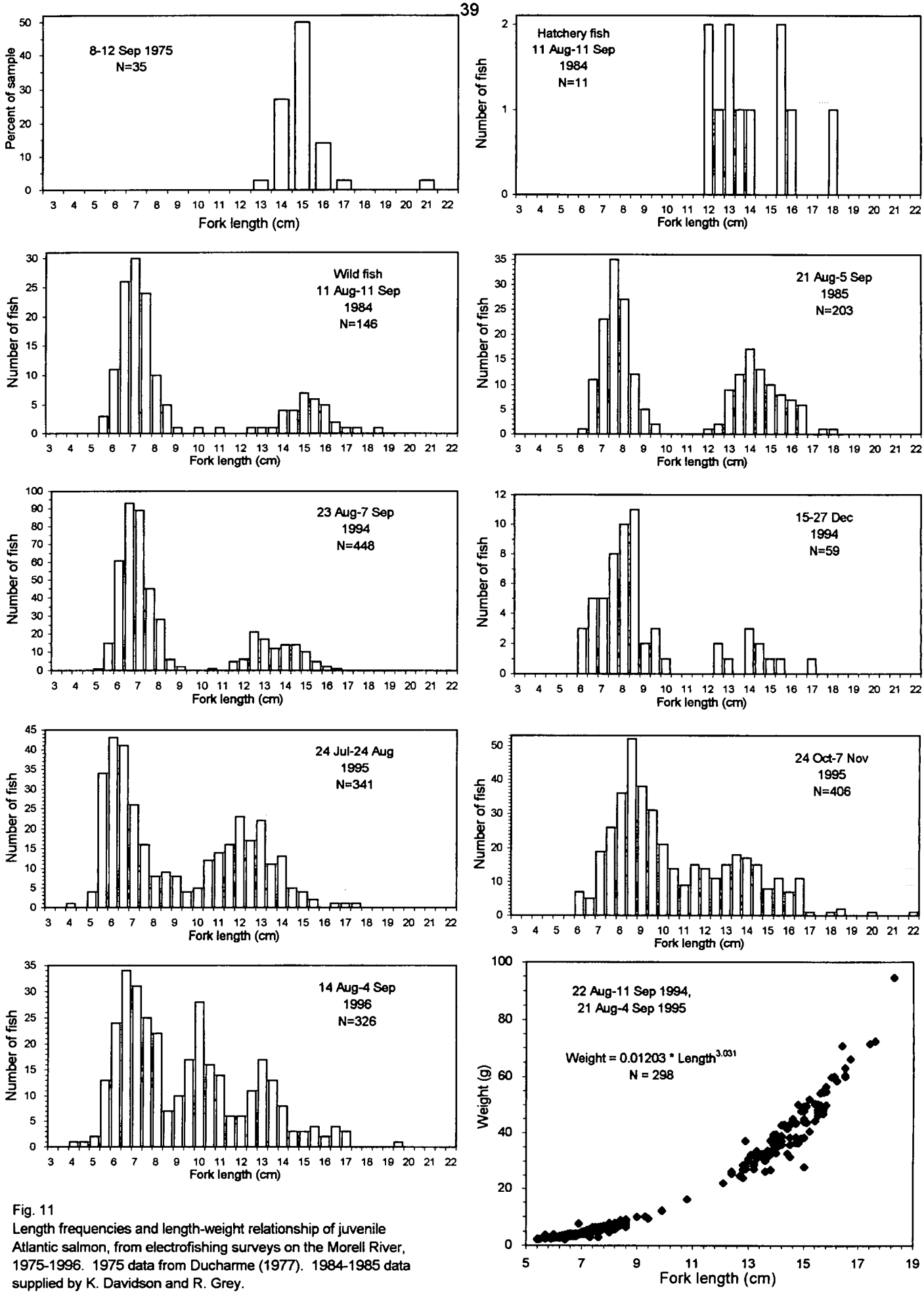



Fig. 11
Length frequencies and length-weight relationship of juvenile Atlantic salmon, from electrofishing surveys on the Morell River, 1975-1996. 1975 data from Ducharme (1977). 1984-1985 data supplied by K. Davidson and R. Grey.

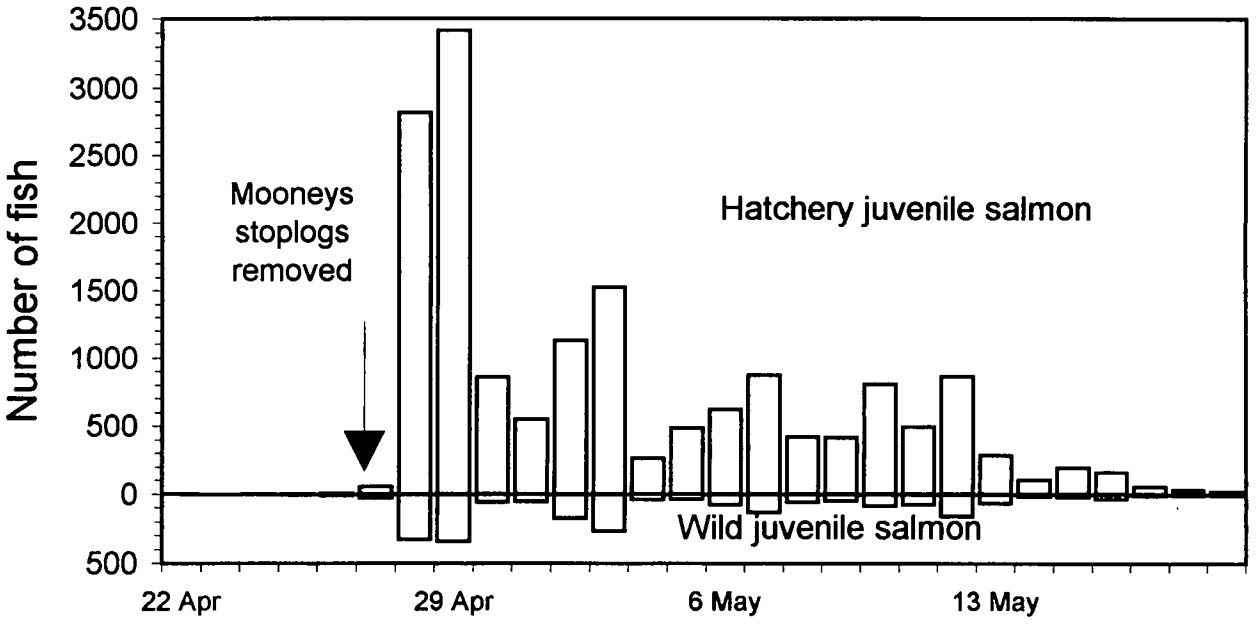



Fig. 12
Downstream movement of hatchery and wild juvenile salmon through the Indian Bridge smolt fence, April-May 1996.

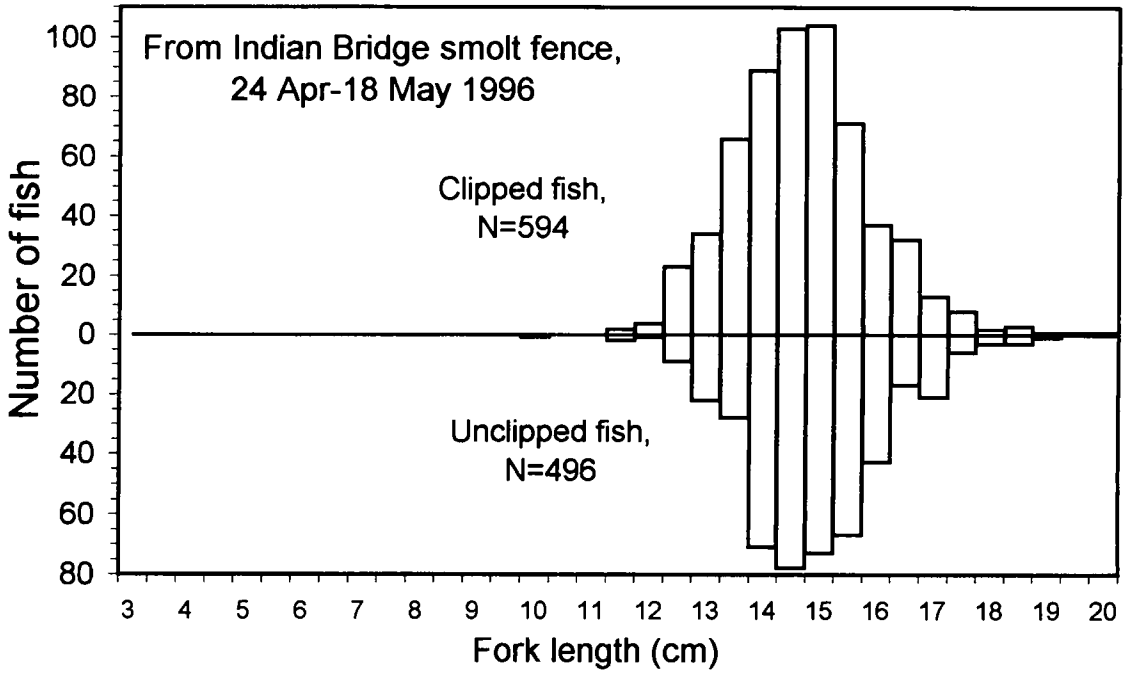
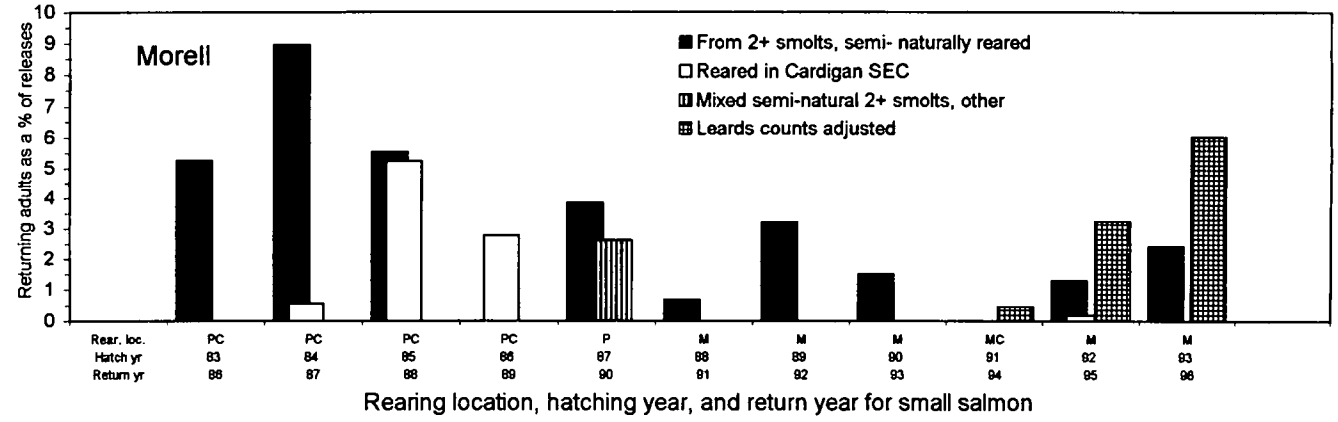
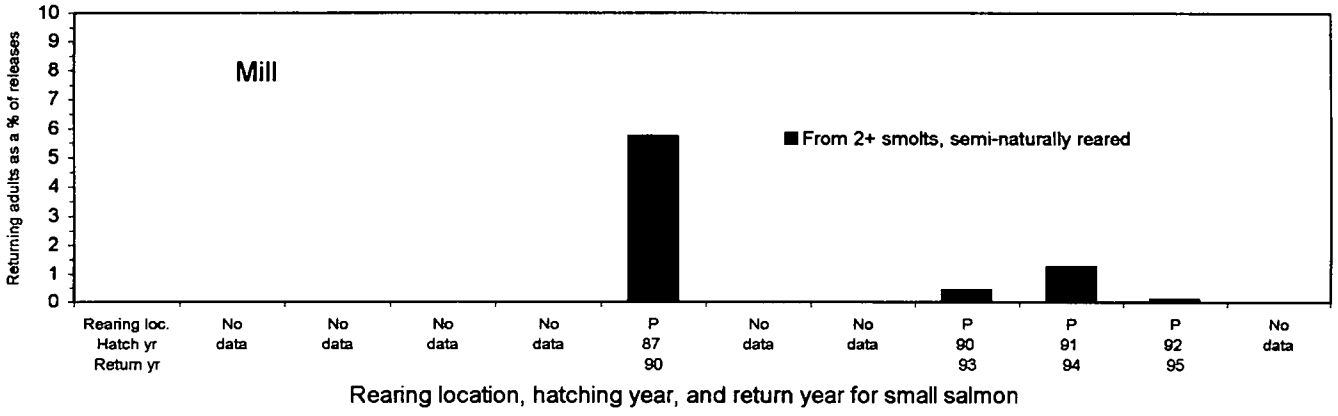
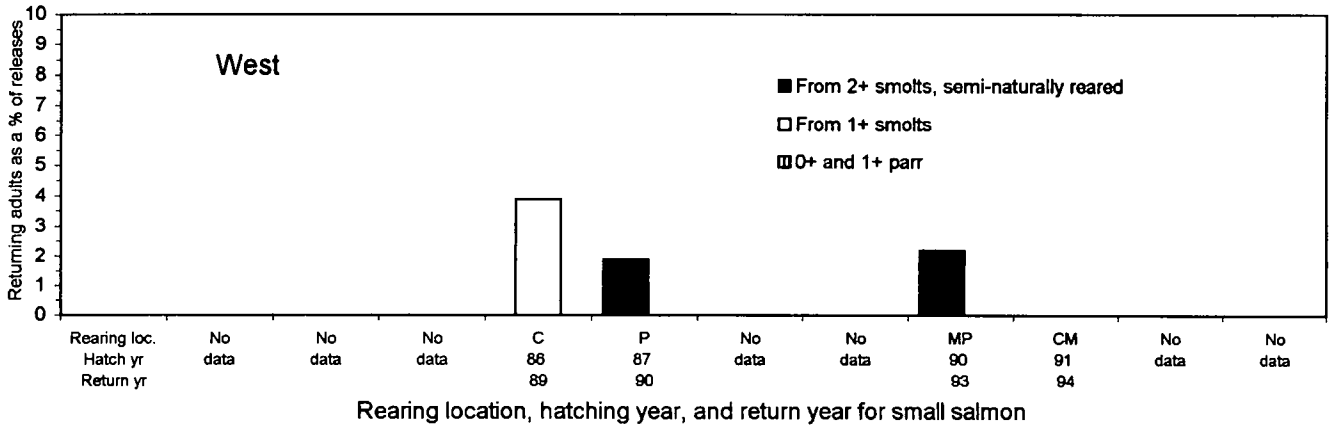



Fig. 13
Frequency distribution of juvenile Atlantic salmon lengths from the Indian Bridge smolt fence.



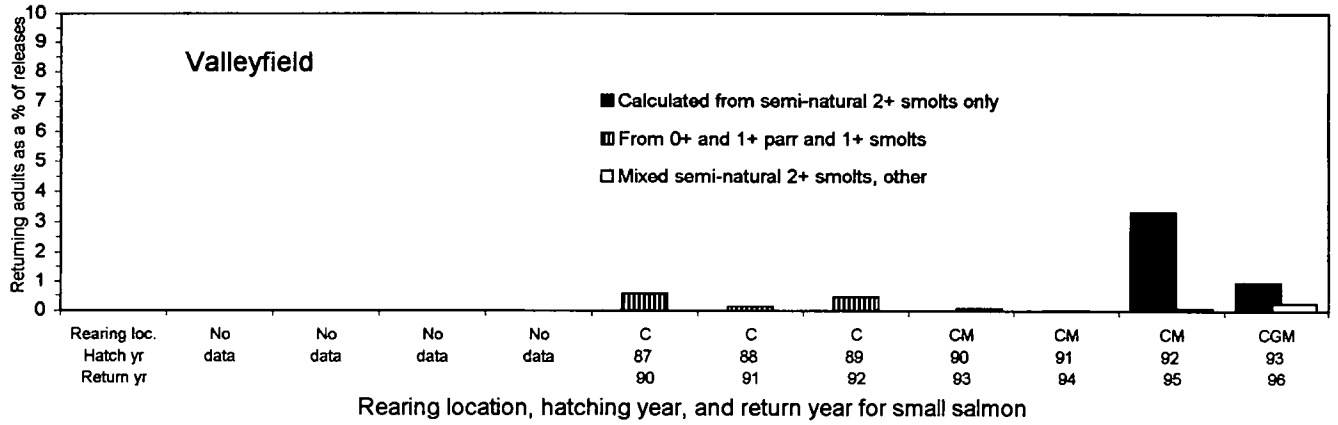




Fig. 14
Return rates of cultured salmon to PEI rivers. Rearing sites are Cardigan SEC (C), Profits Pond (P), Mooneys Pond (M), and Gilberts Pond (G). Semi-natural 2+ smolts include some parr. Return rates are based on hatchery fish only where origin was recorded. Returns for the 1993 cohort do not include large salmon. In the Morell, adjusted Leards counts are corrected for trap efficiency as measured in 1996.

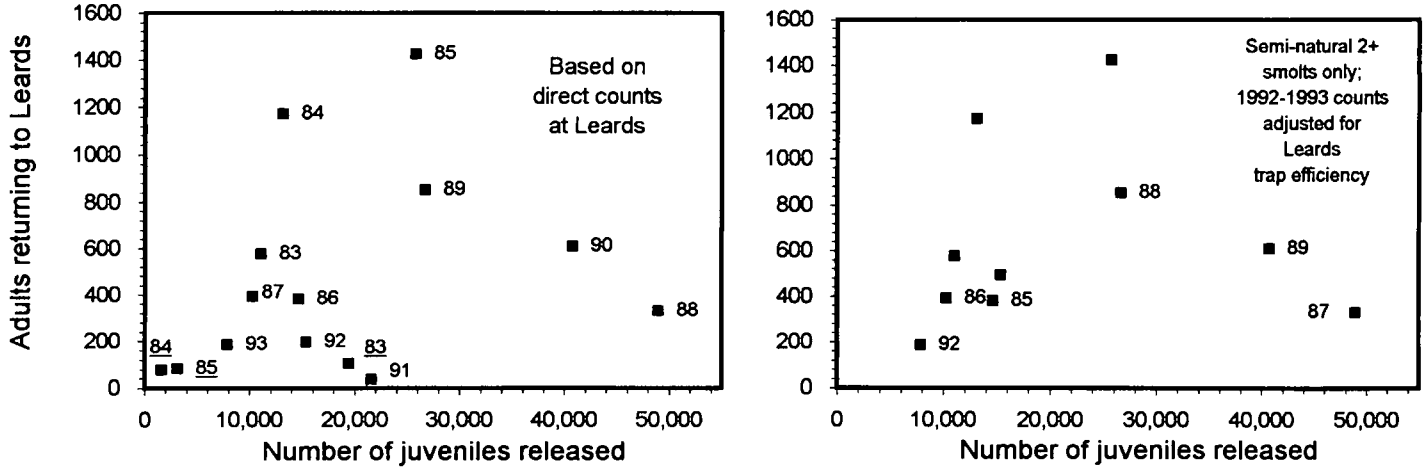



Fig. 15
Relation between the number of salmon stocked above Leards Dam and subsequent counts of hatchery-reared adult fish from the same cohort at Leards fishway. Labels denote the hatching year of the cohort. Underlined labels indicate stocking other than 2+ smolts reared in semi-natural ponds.

Fig. 16
Relation between number of juveniles, hatched in Yr 0 and stocked in the Morell River above Leards Dam, and the number of salmon redds counted above Leards Pond in Yr + 3. Labels indicate Yr + 3.

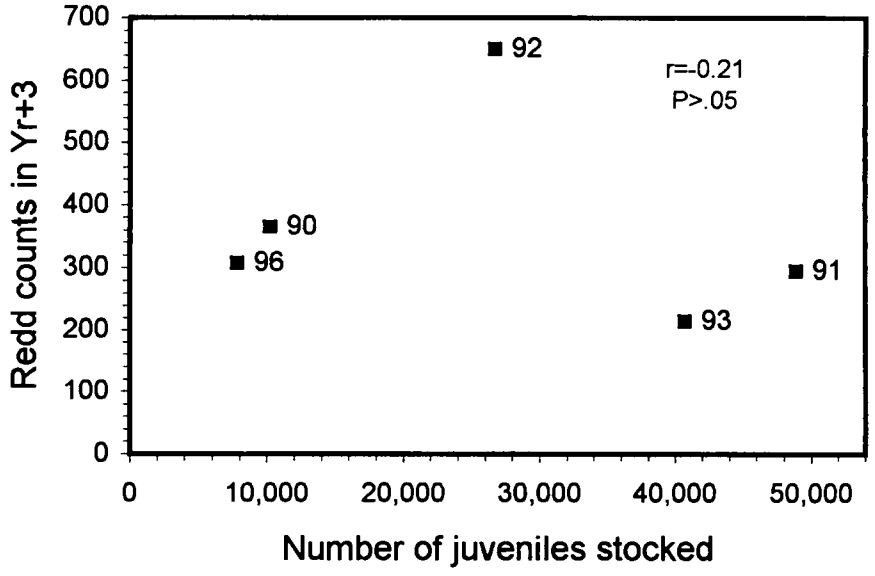
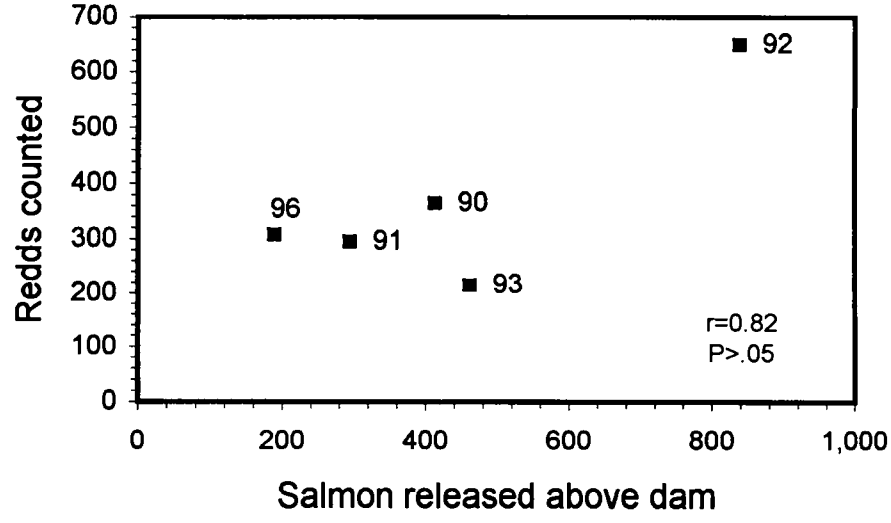



Fig. 17
Relation between the number of salmon released from the Leards fishway into Leards Pond, and the number of salmon redds counted above Leards Pond in the same year. Labels indicate the year of the counts.



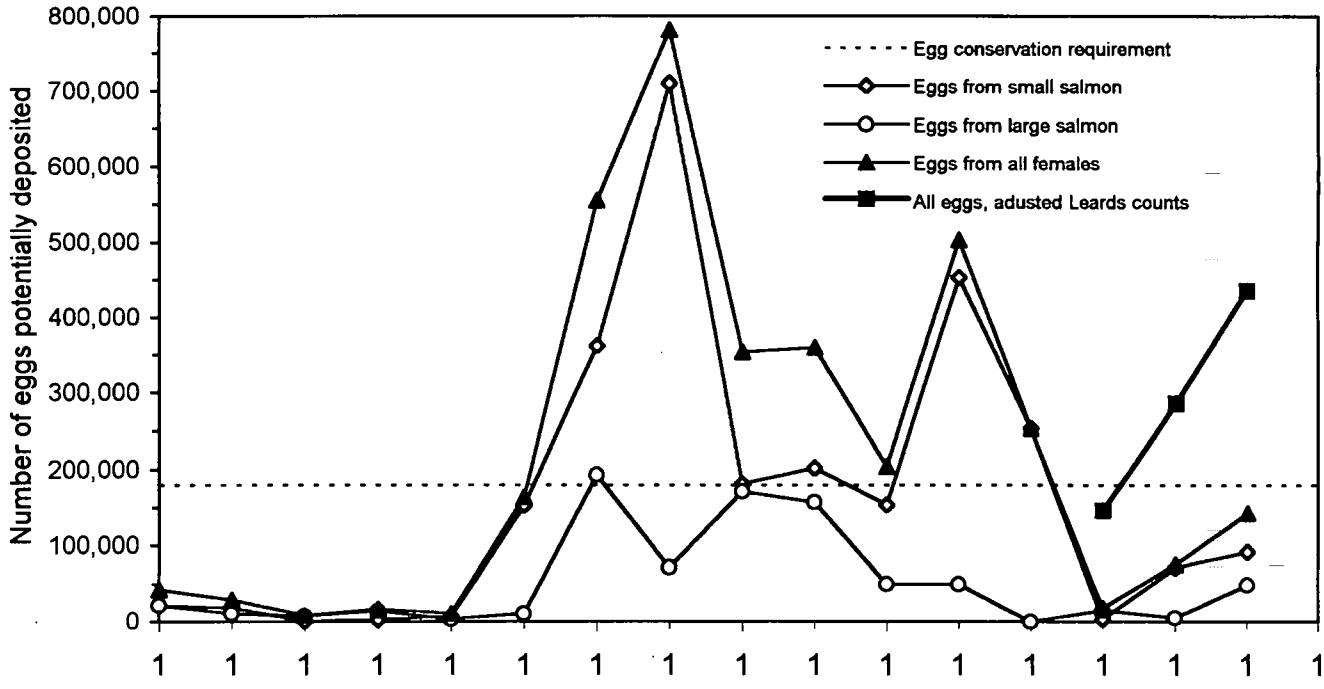



Fig. 18
Potential egg deposition by salmon released above Leards dam, 1981-1996. Deposition from adjusted Leards counts is based on a correction derived from Leards trapping effiency measured in 1996.

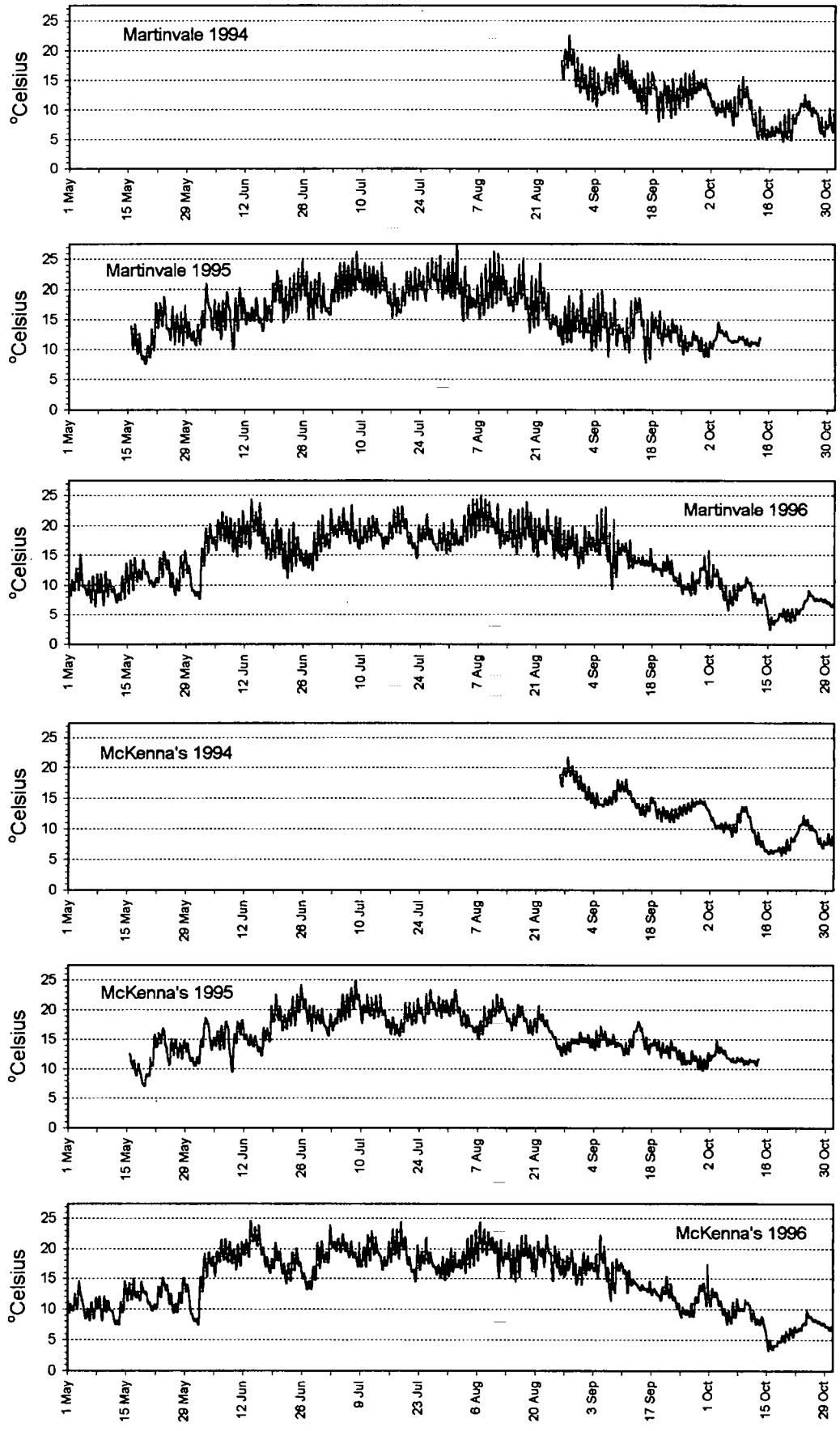



Fig. 19
Morell River water temperatures at Martinvale and McKenna's, 1994-1996.